YOSEMITE NATIONAL PARK

Ecological Restoration and Visitor Experience in East Yosemite Valley Report

National Park Service
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INTRODUCTION

Yosemite National Park is among the nation's most revered and renowned national treasures. Yosemite Valley, with its dramatic cliffs and waterfalls, is the most intensively visited area of the park, attracting more than three million people per year. But it is perhaps the Merced River that is considered the heart of Yosemite Valley and its dynamic network of natural systems. In 2000, the National Park Service approved the *Merced Wild and Scenic River Comprehensive Management Plan* (Merced River Plan) to guide protection of the 81 miles of river that flow in Yosemite National Park. In 2000, the National Park Service also approved the *Yosemite Valley Plan,* which directs specific actions to restore, protect, and enhance the resources of Yosemite Valley; to provide opportunities for high-quality, resource-based visitor experiences; to reduce traffic congestion; and to provide effective park operations, including employee housing.

The Ecological Restoration and Visitor Experience project focuses on two central elements of the *Yosemite Valley Plan* – opportunities for visitor enjoyment and education, and ecological restoration in Yosemite Valley. Ecological restoration links highly valued natural areas that have been degraded or fragmented (including the Merced River, wetlands, meadows, and California black oak woodlands) into a larger, more dynamic ecosystem. As ecological restoration takes place under this project, visitors will be encouraged to enjoy the area's scenic beauty, to recreate along the Merced River in locations that could accommodate more concentrated visitor use, and to learn about the ecological restoration process and the natural and cultural resources in the area.

This report is intended to provide the interested public, agencies, and American Indian tribes with a refinement of the *Yosemite Valley Plan*'s concept of the intended ecological restoration of this area. This report is not intended to meet requirements of the National Environmental Policy Act, the National Historic Preservation Act, or other regulations and policies. The National Park Service will use this document to guide the formal environmental review process for this project. A National Environmental Policy Act (NEPA) document will be released in the future to evaluate a full range of alternatives, disclose potential environmental impacts, and document the planning process.

Background

The land of the former Upper and Lower River Campgrounds, along with a portion of Lower Pines Campground, once looked very different from the areas we see today. American Indians intentionally burned the meadows to promote wildlife habitat and to maintain open California black oak woodlands and their acorns. This practice was discontinued in the middle of the 19th century. As a result, conifers have encroached on what used to be lush meadows and wetlands. Over the years, park managers brought in imported fill material to create suitable campsites. Soil was compacted and wetlands were "dried out." In addition, the riverbanks in the east end of Yosemite Valley have sustained a considerable loss of vegetation and are highly eroded due to intensive visitor use. This has created a wider, shallower, and warmer river with markedly degraded habitat for fish and other aquatic organisms. The area originally consisted of rich loam soils, and wetland, riparian, and meadow communities that supported a diverse variety of sensitive plant and wildlife habitat.

These former campgrounds are part of the Merced River ecosystem, which is considered a highly valued resource in Yosemite Valley. The river and its banks, known as a riparian zone, are increasingly recognized as critical habitat for many plant and animal species. Seasonal flooding of the river is an important natural process that contributes nutrients to wetlands, recharges groundwater, and improves water quality. Restoration efforts would return these important features to the east end of Yosemite Valley.

It is important to note that riparian zones and wetlands are important habitats not only in the park, but throughout the state and the country. Draining, agricultural conversion, and development have resulted in the loss of more than half of the original wetlands in the United States. California has lost more than 90% of its original wetlands, the largest loss of any state (EPA 2001, 2002).

Goals

Specific primary and secondary goals for the project have been set to refine the restoration project, as guided by the Merced River Plan and the *Yosemite Valley Plan*. Long-term success will be measured by attainment of the primary goals. Objectives will be developed from these goals to provide meaningful benchmarks on which to measure success.

Primary

The primary goals are to:

- Provide opportunities for visitors to access the restoration project area and enjoy its scenic beauty;
- Create opportunities for visitors to recreate along the Merced River in areas that can accommodate concentrated visitor use;
- Provide a setting where visitors can learn about the natural and cultural resources in the area, and about the process of ecological restoration;
- Protect and enhance the Merced River's Outstandingly Remarkable Values in Yosemite Valley (see Appendix B);
- Improve the natural function of riverine and adjacent river terrace systems to natural conditions (see Desired Future Conditions);
- Restore geomorphological and vegetation community structure to support natural ecological processes;
- Apply the results of a monitoring program to an adaptive management system that maintains desired conditions.

Secondary

The secondary goals are to:

- Incorporate American Indian traditional ecological knowledge into management practices;
- Enhance culturally important native plant communities, where appropriate, to continue ongoing traditional uses by culturally associated American Indians;
- Substantively contribute to the scientific understanding of dynamic natural processes and requirements for ecological sustainability.

Project Area

The flood of January 1997 played a major role in defining the geographic scope of this project. This was the fifth largest flood in Yosemite Valley since the early 1900s (Eagan 1998), and several campgrounds adjacent to the Merced River and Tenaya Creek were damaged. Water, electrical, and sewer infrastructure was destroyed, along with asphalt roads and parking pads. Fire rings, picnic tables, and food storage lockers were swept downstream. Because these same areas were damaged in the floods of 1950, 1955, and 1964, the campgrounds in this floodplain were subsequently closed.

This project focuses on an approximate 175-acre area in the heart of the Merced River floodplain (Figure 1). The project area includes the flood-damaged former Upper and Lower River Campgrounds, and a portion of Lower Pines Campground, in the east end of Yosemite Valley.

The project area has been divided into segments of the river called *reaches* and *river terrace units* (Table 1). The **riverine reaches** are segments of river including a 150-foot wide band of riverbank on each side of the river. The **river terrace units** consist of the floodplain areas farther than 150 feet from the riverbank. These include the former and existing campgrounds: Group, Backpackers, North and Lower Pines, Upper and Lower River, and the portion of Housekeeping Camp adjacent to the Merced River.

The project area has been divided into six river reaches, which take into account the existing and historical physical, biological, and cultural settings. These individual areas facilitate the phasing of restoration actions to maximize efficiency, localize construction disturbances, and allow for adaptive management practices.

Table 1. Restoration River Reaches and Terrace Units

REACH NAME	INCLUDES
Clark's Bridge	Clark's Bridge to immediately downstream of Sugar Pine Bridge
Tenaya	Tenaya Creek Bridge to confluence with Merced River
Ahwahnee	Downstream of Sugar Pine Bridge to immediately downstream of Ahwahnee Bridge
Stoneman	Downstream of Ahwahnee Bridge to immediately downstream of Stoneman Bridge
Housekeeping Bridge	Downstream of Stoneman Bridge to immediately downstream of Housekeeping Bridge
Housekeeping Camp	Downstream of Housekeeping Bridge to just downstream of Housekeeping Camp
TERRACE UNIT	**INCLUDES**
Pines	North Pines Campground, the Yosemite Concession Services stable, and the southern portion of Lower Pines Campground
Tenaya	Group and Backpackers Campgrounds, and a wetlands complex north of Group Campground
Stoneman	North end of Lower Pines Campground and the overflow channels with the Merced River meander between Sugar Pine and Ahwahnee Bridges
Rivers	Both former Upper and Lower River Campgrounds
Housekeeping	Only the portion of Housekeeping Camp proximal to the Merced River

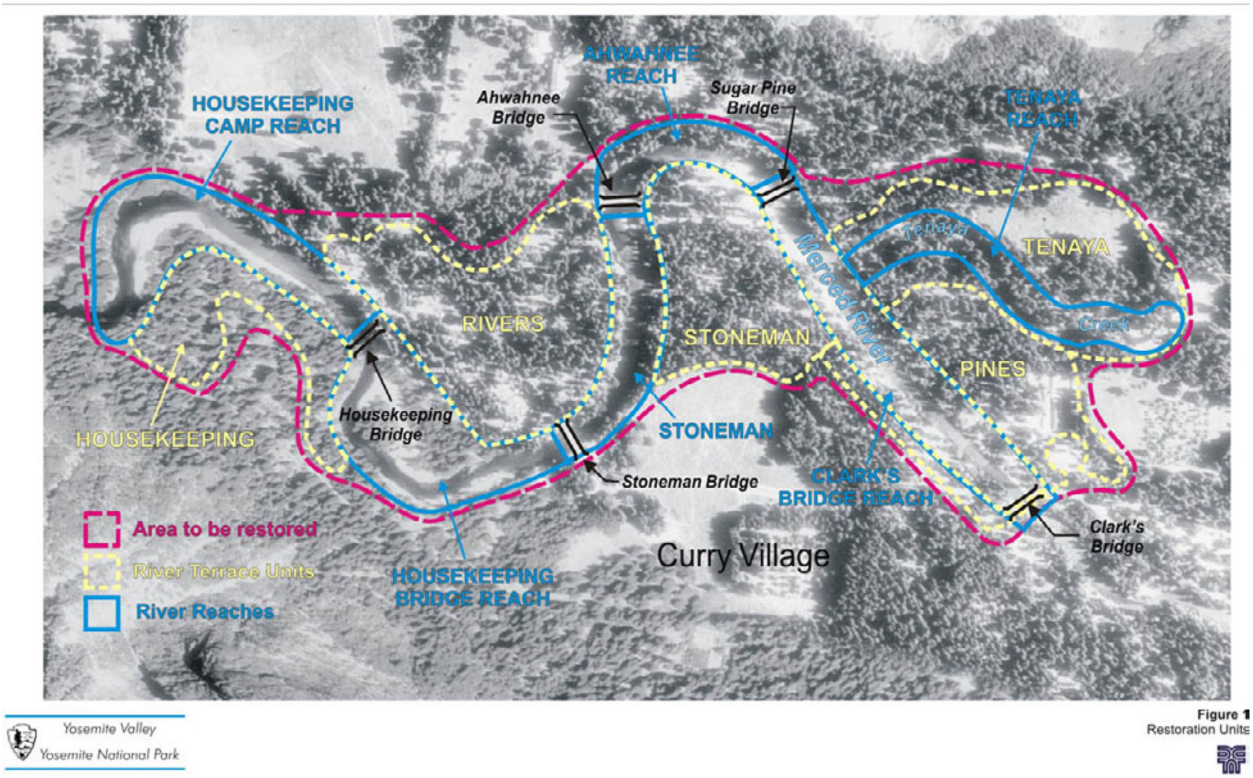


Figure 1. Restoration Units

Visitor Experience

Ecological restoration of former campground areas will open up exciting possibilities for park visitors. In the past, only those who secured a campsite in the current project area were able to freely enjoy that segment of the Merced River in Yosemite Valley. As campgrounds, these locations were largely set aside for the experience of campers, thus excluding most other visitors. As part of the ecological restoration plan, all visitors will be allowed to experience the dynamic processes of this floodplain ecosystem.

As called for in the Yosemite Valley Plan, and in keeping with zoning requirements specified in the Merced River Plan, visitors will have the opportunity to enjoy a variety of activities within the ecological restoration area. These activities include picnicking, photography, hiking, biking, bird and other wildlife watching, swimming, wading, non-motorized boating, fishing, enjoying the natural quiet, and nature study. Interpretive signs and displays will help visitors explore and learn about the complex natural processes taking place and the importance of preserving these special habitats. Restoration areas will be ideal locations for interpretive ranger walks, junior ranger programs, and other educational group activities.

According to the Merced River Plan, the river segments associated with this project are considered a Day Use zone, which:

> *. . . is intended to be applied to popular park destinations, where visitors could spend significant periods of time enjoying park resources in a relatively accessible setting. The Day Use zone enhances opportunities for visitors to enjoy more intensive recreational activities near the Merced River and supports a range of active recreational opportunities . . . which contributes to the diversity of experiences specified in the recreation Outstandingly Remarkable Value.*

While visitors will have overall greater access to the former campground areas, there will also be some limitations on where specific activities can take place. Sensitive habitats, such as wetlands and riverbanks, are especially vulnerable to trampling and require special protection. Visitors will be directed away from these areas across boardwalks or trails that skirt these habitats. While people will be allowed to enjoy viewing, wading, or swimming in the Merced River, they will be directed to sand and gravel bars, which are naturally created where the flow of the river slows. These sandy areas are more resistant to trampling and make pleasant beaches from which to enjoy the river.

In keeping with the Yosemite Valley Plan, some of the trails through the restoration site will be fully accessible according to Americans with Disabilities Act guidelines and will meet the needs of people with mobility impairments. These trails will connect with those in the surrounding area to allow visitors to continue to other points of interest in Yosemite Valley. For example, a multi-use trail will link the Yosemite Village area with Curry Village and trails to The Ahwahnee and Mirror Lake. Along the way, informal paths will lead visitors around wetland areas, interpreting the hydrologic processes and heralding their return. Trails also will direct visitors to beaches along the Merced River and other secluded spots where visitors can enjoy swimming, picnicking, and natural quiet. As winter turns to spring, viewing the river as its waters rise slowly over the banks and spill into wetlands and meadows can be a dramatic and unforgettable experience.

As part of both the Merced River Plan and the *Yosemite Valley Plan,* the park is developing a Visitor Experience and Resource Protection (VERP) process. This process has been developed for the National Park Service to help manage the impacts of visitor use on visitor experiences and resource conditions in national parks. The VERP framework is based on the concept of desired conditions, which are contained in the Merced River Plan's management zoning prescriptions that identify how different areas in the river corridor are to be managed. Indicators and standards are being established to reflect the desired conditions of a particular area. Detailed monitoring will then take place. If monitoring reveals that a standard is being exceeded, desired conditions may not be realized and management action will be taken. If a standard is exceeded due to impacts associated with visitor use, actions may be taken to manage or limit visitor use. Any such management actions will fully comply with the requirements of the National Environmental Policy Act and other applicable legislation.

A map describing the opportunities and constraints for visitor experience is located in Appendix A.

PROJECT AREA DESCRIPTION AND ISSUES

River Mechanics

Floodplains in Yosemite Valley play a critical role in the dynamics of the Merced River ecosystem. High winter and spring flows create wet areas in side channels, low-lying wetlands, meadows, and overflow channels. These wet areas support amphibians and aquatic invertebrates throughout the relatively dry summer. These periodic inundations flush sediments and vegetation litter from the low-lying areas and river terraces into the river channels, providing nutrients that form the base of the aquatic food chain. Euro-American settlement activities, however, significantly altered river mechanics through bridge construction, riverbank armoring, and infrastructure development (Milestone 1978).

Several bridges within the project area, including Sugar Pine Bridge, affect natural river flow patterns (NPS 1991). As floodwaters rise, the closing arch of the bridge restricts the amount of water that can pass under the bridge and through the main channel. Thus, the bridge creates a backwater in the main channel during regular high water periods. This backwater flow, in conjunction with Tenaya Creek, which enters the Merced River just upstream of the bridge, is deflected by Sugar Pine Bridge toward the left bank at the upstream side of the bridge. Since 1919, one cut-off channel has enlarged from 20 to 80 feet wide (as measured by long-term river morphology transects), allowing it to carry large amounts of water during moderate to high flow events (NPS 1997a). If Sugar Pine Bridge continues to restrict flow, this cut-off channel has the potential to capture the entire flow of the river, with significant ecological effects downstream. If this occurs, the river would flow out of the cut-off channel directly upstream of the historic Ahwahnee Bridge. This would place tremendous erosional forces on the right bank of the Merced River at former Upper River Campground (NPS 1997b).

Water flowing through the single-arch span of Sugar Pine Bridge is constricted by the abutments even under low flows. The inside span of the single arch is 106 feet wide, whereas the width of the river at this point is 187 feet (Milestone 1978). This constriction causes water to accelerate through the bridge, increasing its ability to move riverbed materials. As a result, the bed at the bridge abutments and immediately downstream of Sugar Pine Bridge has been scoured, creating an unnaturally deep pool and causing increased erosional forces along the right bank (outside bend) of the meander bend between Sugar Pine and Ahwahnee Bridges. This has necessitated extensive placement of rock riprap along the entire reach between these two bridges, decreasing riparian vegetation and habitat.

A similar situation is occurring at the two other bridges within the project area: Stoneman and Housekeeping Bridges. These bridges also constrict the channel width, causing increased velocities during high flows that result in the formation of downstream scour pools and mid-channel bars. These mid-channel bars in turn accelerate lateral bank erosion. Floodwaters backing up behind the bridges cause erosion along both banks (Milestone 1978).

Concentrated visitor use within the riparian corridor has resulted in the loss of bank-protecting vegetation and bank cohesion, which exacerbates bank erosion. Visitor access to the river is often at sites that are subject to erosion and not at appropriate sites such as sand and gravel bars created by lateral deposition. Due to these impacts, the Merced River has grown wider and shallower throughout the project area (NPS 1991).

Opportunities exist to address many of these issues. River mechanics can be improved by removing Sugar Pine Bridge and stabilizing the eroding banks (NPS 1991).

Deciduous Riparian Woodland Community

Riparian plant communities occupy the vital connection between aquatic and terrestrial ecosystems. In Yosemite Valley, riparian corridors support broad-leaved deciduous woodlands dominated by native species such as white alder (*Alnus rhombifolia*), black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), and various willows (*Salix* spp.). Flooding frequently disturbs this woodland community by depositing and removing soil. The plant species common to this woodland community thrive under these conditions.

As the Merced River has been affected by human activities, so have the riparian communities. Annual flooding regimes have been altered by channelization of the river, and fill has been used to elevate, flatten, and dry out historic riparian corridors for campground development. Intensive visitor use has resulted in soil compaction and loss of vegetation cover. The result is increased riverbank erosion, along with an increase of lateral flows around mid-channel bars created by the bridges. These disturbances resulted in the loss of riparian plant communities that once lined the river. Today in the project area, only remnant patches of riparian communities are found interspersed with barren or riprap-lined riverbanks.

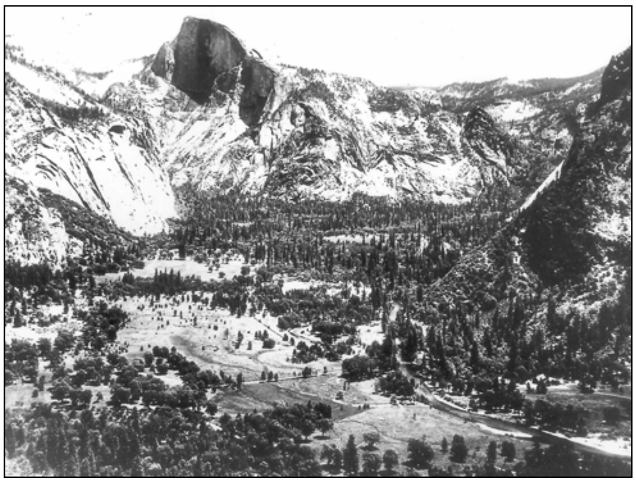
California Black Oak Woodland Community

Pollen studies suggest that around 650 years ago there was a major shift in dominant vegetation types from coniferous forests to open stands of oaks and shrubs (Anderson et al. 1991). This study postulates that a change in climate along with a possible high intensity fire evidenced by a charcoal influx may have shifted the vegetation type. This may have provided an opportunity for local Indians to manage the land for sustained open stands of California black oak (*Quercus kelloggii*) through regular burning and manual removal of young conifers. These oaks provided them with staple acorns. The cessation of these American Indian land management practices in the late 1800s (Anderson 1996) and impacts from development and visitor use caused dramatic changes to the forest appearance. Conifers rapidly expanded into California black oak woodlands and meadows (Gibbens and Heady 1964). Their relatively rapid increase in height allowed ponderosa pine and incense-cedar to quickly overtop and crowd out the oaks. California black oaks are still present in the project area, but they are no longer the dominant species and are not thriving.

Meadow Communities

In the past, meadow communities in Yosemite Valley were more widespread than they are today. This change in meadow extent has been documented in early photographs (Gibbens and Heady 1964). Encroachment of trees into meadows has been noted since the late-1800s (Commissioner Reports 1880-1906, Superintendent’s Monthly Report 1924-1963). According to a survey conducted in 1866, there were 746 acres of meadow and 396 acres of “fern and high lands” in the Valley. A more current analysis of vegetation in Yosemite Valley reveals that about 360 acres of meadow remain (NPS 1994).

Euro-American settlement of Yosemite Valley brought an end to natural fire and annual burning by Indians (Anderson 1996). This diminished not only the California black oak woodland community, but the meadow communities as well. The new settlers also farmed the meadows, and allowed cattle and pack animals to graze there. During the 1860s and 1870s, draining the wet meadows through ditching was a common practice to convert meadows to agricultural purposes. As automobile use increased, grazing declined. Wet meadows were filled to allow development of camping sites, parking lots, and other facilities. Roads required additional ditching and other hydrological alterations (Gibbens and Heady 1964). As a result of these changes to the natural fire regime and hydrology, non-native vegetation increased at the expense of native wetland species.



This 1899 photograph shows many open meadows and few conifers.

By 1961, the size of meadows has decreased dramatically due to the cessation of natural and American Indian managed fire and human alterations to the natural hydrological system.

Aquatic Communities

Over the years, aquatic habitats have been degraded on several fronts. As the river has widened and become shallower due to human impacts and manipulation of the river, summer water temperatures have increased. Large woody debris, critical for high quality in-stream habitat (Gallagher 1998), was considered a hazard to bridges and river users and was routinely removed from the river until 1991. The loss of riparian vegetation and woody debris reduced shading and cover habitat (Kisanuki and Shaw 1992) and reduced instream deposition of organic material, a building block of the aquatic food chain.

The Merced River and its floodplain support a variety of fish, amphibians, aquatic insects and other invertebrates that are well adapted to local conditions. These conditions include near neutral pH, low nutrient concentrations, and a Mediterranean climate. Many fish currently found in the Merced River and its tributaries in Yosemite have been introduced. Prior to trout stocking for sport fishing, native fish in Yosemite Valley were probably limited to the rainbow trout and the Sacramento sucker. Rainbow trout are the only trout species native to the Merced River in Yosemite Valley. Rainbow trout introduced through stocking from other waters and fish hatcheries have now hybridized with, and/or displaced, the original strain. Brown trout, a species of trout not native to California, has also been introduced into the Merced River in Yosemite Valley and downstream.

Amphibians have suffered population declines in the Valley similar to those noted in the rest of the Sierra Nevada. The California red-legged frog, a species listed as threatened under the Federal Endangered Species Act, likely once occurred in the Valley but is now extirpated. Loss of perennial shallow water and wetland habitat, and predation by non-native bullfrogs and stocked fish have contributed to the decline of the California red-legged frog and of amphibian populations in general.

Groundwater Dynamics

Historical land use studies indicate that groundwater conditions in Yosemite Valley meadows were altered by human disturbances (Milestone 1978; Gibbens and Heady 1964). Water flows from the Valley walls were channeled and otherwise altered with the increase of farming, roads, and developed areas such as The Ahwahnee, Yosemite Village, Yosemite Lodge, and Curry Village. This reduced the opportunities for water to seep into the meadows and recharge the near-surface groundwater resources. In turn, shallow groundwaters were reduced during the growing season, changing wetland and vegetation conditions between the Valley walls and the Merced River.

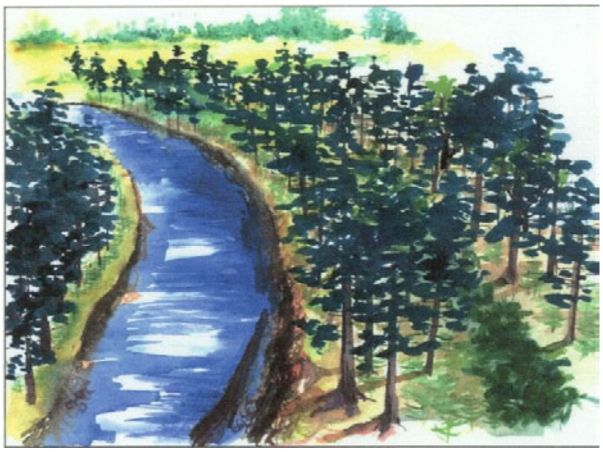
Water flow from the Valley walls is still diverted with numerous ditches near The Ahwahnee and Curry Village. These diversions affect near-surface groundwater levels within the project area.

Scenic Vistas

At the time of Euro-American settlement in the mid- to late 1800s, there were grand vistas of meadows, oak woodlands, and granite walls throughout Yosemite Valley. The rapid expansion of conifers into the California black oak and meadow communities dramatically changed those conditions. During the late 1800s and early 1900s, park managers noted that the increased range and rapid growth of conifers were blocking views. They initiated programs of tree removal from meadows to maintain and enhance these views (Gibbens and Heady 1964). Today, views of the Valley walls are significantly impacted by dense stands of ponderosa pine (*Pinus ponderosa*) and incense-cedar (*Calocedrus decurrens*) in the project area and throughout Yosemite Valley.

DESIRED FUTURE CONDITIONS

The desired future conditions would allow hydro-geomorphic processes of the Merced River and Tenaya Creek to function as closely as possible to the way they functioned before Euro-American settlement. Overland flow and groundwater recharge systems would be restored to their properly functioning conditions. The Merced River would be reconnected to its floodplains. To the greatest extent possible (keeping in mind infrastructure constraints), the river would be free to meander within natural, rather than artificial, confinements. The river would be narrower, with an appropriate width to depth ratio. It would contain complex in-stream structures (e.g., woody material, aquatic vegetation, and geomorphic material) and would exist within an intact riparian plant community.



The existing condition includes the river with eroded banks, a lack of deciduous riparian vegetation, and a dense coniferous forest in the floodplain.

The desired future conditions include a deciduous riparian forest with restored and stabilized riverbanks, and with woody debris in the river channel.

The dense ponderosa pine and incense-cedar dominated forests would be thinned, allowing for the return of a mosaic of meadow, riparian, and oak woodlands. Deciduous riparian woodlands would once again line the river. The composition of these communities would reflect the tree density, understory, and herb cover naturally found within these communities in less disturbed areas of the park. Ponderosa pine and shade tolerant conifers would be removed from meadow habitat and non-native weeds would be controlled. Fuel loading (forest litter, duff, logs, and snags) would range from sparse to light.

The outstanding scenic vistas would be restored through vegetation management actions later described for the river terrace units.

GUIDING PRINCIPLES

Guiding principles, as used here, are a set of scientifically-based concepts commonly accepted in the field of ecosystem restoration that form the foundation for the actions prescribed in this plan. All prescribed recommendations in this ecological restoration project adhere to these principles.

- Ecosystem restoration is a dynamic process that occurs over time. It is not necessarily a series of prescriptive actions, but rather a long-term process that is only begun and aided by the actions taken.
- Ecological processes operate in spatial and temporal dimensions. Restoration actions must take into account that ecological conditions are not static, but are shaped by past conditions and, in turn, shape future conditions.

- Stochastic events (e.g., unpredictable events such as floods and fire) are a part of these natural processes. A restored system must be resilient and capable of recovering from natural disturbances.
- Actions taken will not immediately result in full attainment of the desired future conditions, but will set the stage for ecological processes to be restored to properly functioning conditions.
- Restoration actions must complement the watershed's hydro-geomorphology and vegetation communities. The actions taken must not oppose the ecological processes of the watershed.

ASSUMPTIONS

- Over the course of the last 150 years, changes to the Merced River have been caused by multiple human-caused disturbances (riprap, bridges, streambank use, etc.). Therefore the project area cannot be restored by focusing on a single disturbance.
- Narrowing the Merced River channel in an attempt to restore the former width-to-depth ratio will not result in unnatural downcutting. Because this reach of the river has a low gradient, the height of the river channel is controlled by the elevation of the terminal moraine downstream.
- Restoring river mechanics and plant communities will increase the biological diversity and integrity of the east end of Yosemite Valley. Biological integrity is defined as the ability of the system to support and maintain a balanced, integrated, adaptive community of organisms having species composition, diversity, and functional organization comparable to that of a natural habitat of the region.
- Removing historic fills and narrowing the river channel will increase potential for the river to periodically overflow its banks. This in turn will restore historic geomorphic features (channels) and sediment transport processes.
- Vegetation communities will require continued management to sustain desired conditions. For example, prescribed burning will be used as a substitute for naturally and culturally occurring fire. Non-native plants will also be managed as weed seeds are inadvertently introduced.

OTHER CONSIDERATIONS

- Phased funding will be required to carry out the complete restoration.
- Coordination with other park projects will be required to ensure the success of the project.
- The removal of Northside Drive from Curry Village to Camp 6 in Yosemite Village will require careful phasing to accommodate ongoing transportation needs.
- Native root rot species, including Annosus and *Armillaria*, are abundant in sections of the project area. This will affect species selection for revegetation.

DESIGN CRITERIA

The design of the ecological restoration project should:

- Support the goals and objectives of the Merced River Plan;
- Complement natural processes working within the Merced River watershed;
- Protect and enhance the river's Outstandingly Remarkable Values as defined in the Merced River Plan (and described in Appendix B). Where a conflict between values exists, the net effect to Outstandingly Remarkable Values must be beneficial;
- Meet requirements of Section 7 of the Wild and Scenic Rivers Act;
- Be compatible with Merced River Plan management zone goals (River Protection Overlay, Diverse Visitor Experience Zone, and Developed Zone);
- Be compatible with desired visitor experience and resource conditions within the Visitor Experience and Resource Protection (VERP) framework;
- Allow phasing of infrastructure removal and replacement (e.g., sewer line through Housekeeping Camp);
- Promote sustainability, such as reuse of materials and the balance of project-generated and needed materials within the project area, Yosemite Valley, and the whole park to minimize costs, impacts, and waste;
- Relocate trails to capitalize on key resource opportunities (views, river, and resource areas) without compromising restoration goals;
- Provide opportunities for culturally associated American Indians to use trees removed by thinning.

PLANT PROPAGATION

A contract for seed collection and propagation will be initiated to protect the genetic integrity of locally adapted native plant species. Seed collection will be limited to the east end of Yosemite Valley and concentrated within the project area. Plants in areas to be graded will be salvaged when possible, held off-site at an appropriate facility and replanted following ground-disturbing activities. To secure needed plant materials, seed collection will begin at least one year in advance of project implementation. Some of the species to be grown for restoration efforts are listed in Table 2.

Table 2. Plant Species to be Propagated and Salvaged

Common Name	Scientific Name
California black oak	*Quercus kelloggii*
White alder	*Alnus rhombifolia*
Big-leaf maple	*Acer macrophyllum*
Black cottonwood	*Populus balsamifera* ssp. *trichocarpa*
Western azalea	*Rhododendron occidentale*
Red willow, shining willow	*Salix lucida* ssp. *lasiandra*
American dogwood	*Cornus sericea* ssp. *occidentalis* or ssp. *sericea*
Pacific dogwood	*Cornus nuttallii*
Small fruited-bulrush	*Scirpus microcarpus*
Sedge	*Carex* spp.
Rush	*Juncus* spp.
Deergrass	*Muhlenbergia rigens*

BIOENGINEERING

Bioengineering is the use of live plants and woody debris to alleviate erosion and stabilize riverbanks. These techniques improve water quality and enhance wildlife habitat by providing cover and nutrients to the aquatic ecosystem. Previously used armoring structures such as riprap, which are piles of rock placed along riverbanks, do not add any biological benefit to the river ecosystem.

Several bioengineering techniques have been used in Yosemite National Park to stabilize banks. These include brush layering, hydrodrilling, and tree revetments (NPS 1996, USFS 2002). Examples of these techniques can be seen at the Devil's Elbow, Housekeeping Camp, and Eagle Creek restoration project sites.

Brush layering involves the use of an excavator to place alternating layers of live cuttings, branches, logs, and soil into eroded banks. Hydrodrilling uses a pressurized stream of water to form holes 4-5 feet deep in which dormant willow or cottonwood cuttings can be planted. The depth of the holes allows the cuttings to reach the water table for most of the year, allowing the cuttings to take root and grow. Tree revetments are logs placed along an eroded or scoured bank. They provide a temporary protective barricade that traps sediments and allows revegetation to occur. Other bioengineering techniques such as terraced crib, brush mattress, or branch packing (USFS 2002) may be used in future restoration projects.

RIVER PROTECTION OVERLAY RECOMMENDATION

The areas immediately adjacent to the river channel, along with the river channel itself, are particularly important to the health and proper functioning of the river ecosystem. These areas allow for the main channel to link with backwater areas, tributaries, and groundwater systems; provide for increased channel diversity; and contribute sources of needed nutrients and woody debris to the river.

Additionally, the areas immediately adjacent to the river channel can help protect surrounding development from potential flood damage and can be used to filter runoff water draining into the river.

To ensure the river channel itself and the areas immediately adjacent to the river are protected, the Merced River Plan includes a management tool called the River Protection Overlay. Measured during ordinary high water, the River Protection Overlay extends 150 feet on both sides of the river, including the river channel itself. The River Protection Overlay is also intended to identify the location of highest priority for restoration of hydrologic processes and biotic habitats within the river corridor. This critical zone will provide a buffer area for natural flood flows, channel formation, riparian vegetation, and wildlife habitat and protect riverbanks from human-caused impacts and associated erosion.

The River Protection Overlay was preliminarily mapped within the project area in 2002. Implementation of the River Protection Overlay will result in long-term benefits to the river system and plant communities to which it is linked.

Recommendations to Protect the River Protection Overlay

- In some sensitive areas, fence the boundary of the River Protection Overlay using low split-rail wooden fence.
- Install interpretive signs that describe the purpose of the River Protection Overlay and its importance to restoring the Merced River and riparian corridor.
- Remove non-essential facilities from the River Protection Overlay, unless such actions conflict with cultural resource protection goals.
- Create appropriate river access points at sand and gravel lateral deposition bars for visitors.

RIVERINE REACH RECOMMENDATIONS

Desired Future Conditions

The Merced River channel would be narrower than it is at present, more closely approximating conditions that existed prior to Euro-American alteration of the system. Park data from 1919 will be referenced to achieve a more appropriate width-to-depth ratio. The channel would have the minimum amount of hardened shoreline (riprap) needed to protect essential facilities such as bridges, roads, and trails. Large woody material in the channel would add complexity, improving channel habitat conditions. A deciduous riparian woodland community would be established along the shoreline. Shorelines would be stable because of healthy riparian and near-shore conditions. Floodplains would be connected to the river and flood at regular and appropriate return intervals. Visitors would access river in appropriate sites and enjoy vistas through newly restored riparian corridors.

Clark's Bridge Reach

- Evaluate existing riprap along banks. If removal will not threaten essential facilities or result in excessive bank erosion, replace with vegetation to provide shade and cover for aquatic organisms. Otherwise attempt to revegetate among the riprap.

- Rebuild eroded riverbanks and stabilize new shorelines with bioengineering techniques such as brush layering.
- Add large woody debris to help stabilize banks and increase in-stream habitat complexity.
- Establish sustainable and functioning deciduous riparian woodland community along entire reach through revegetation of native plants.
- Remove Sugar Pine Bridge and stabilize the shoreline.

Tenaya Reach

- Rebuild eroded riverbanks and stabilize new shorelines with bioengineering techniques such as brush layering.
- Allow large woody debris to remain in stream to increase in-stream habitat complexity.
- Remove Himalayan blackberry (*Rubus discolor*) and other non-native vegetation.
- Establish sustainable and functioning deciduous riparian woodland community along entire reach through revegetation of native plants.
- Plant locally native sedge, rush, and bulrush in deciduous riparian woodland at confluence of Tenaya Creek and Merced River.
- Remove sewer lift station and associated electrical lines at confluence with the Merced River.

Ahwahnee Reach

- Remove the west approach road to Sugar Pine Bridge and revegetate disturbed ground. Remove fill material and re-use it to narrow the unnatural cutoff channel. Stockpile asphalt and road fill in approved sites for re-use.
- Provide for visitor access at sand and gravel bar on the inside bend of the river.
- Evaluate existing riprap along banks. If removal will not threaten essential facilities or result in excessive bank erosion, replace with vegetation to provide shade and cover for aquatic organisms. Otherwise attempt to revegetate among the riprap.
- Rebuild eroded riverbanks and stabilize new shorelines with bioengineering techniques such as brush layering.
- Add large woody debris to help stabilize banks and increase in-stream habitat complexity.
- Establish sustainable and functioning deciduous riparian woodland community along entire reach through revegetation of native plants.

Stoneman Reach

- Remove fill material from the riparian corridor and floodplain channels at the former River Campgrounds. Stockpile fill material in approved locations for use in river channel restoration.
- Evaluate existing riprap along banks. If removal will not threaten essential facilities or result in excessive bank erosion, replace with vegetation to provide shade and cover for aquatic organisms. Otherwise attempt to revegetate among the riprap.

- Rebuild eroded riverbanks and stabilize new shorelines with bioengineering techniques such as brush layering.
- Add large woody debris to help stabilize banks and increase in-stream habitat complexity.
- Establish sustainable and functioning deciduous riparian woodland community along entire reach through revegetation of native plants.

Housekeeping Bridge Reach

- Continue previous restoration efforts along entire bank of river.
- Provide for continued rafter access immediately below Stoneman Bridge (left bank looking downstream), but protect adjacent riparian communities and stabilize adjacent riverbanks.
- Provide for visitor access at sand and gravel bar on the inside bend of the river.
- Rebuild eroded riverbanks and stabilize new shorelines with bioengineering techniques such as brush layering.
- Add large woody debris to help stabilize banks and increase in-stream habitat complexity.
- Establish sustainable and functioning deciduous riparian woodland community along entire reach through revegetation of native plants.
- Evaluate existing riprap along banks. If removal will not threaten essential facilities or result in excessive bank erosion, replace with vegetation to provide shade and cover for aquatic organisms. Otherwise attempt to revegetate among the riprap.

Housekeeping Camp Reach

- Continue previous riverbank restoration along entire reach of river except at the sand and gravel bars where visitors will access the river.
- Provide for visitor access at sand and gravel bar on the inside bend of the river.
- Stabilize riverbanks while maintaining and restoring hydrologic connections to the wetlands to the north.
- Establish sustainable and functioning deciduous riparian woodland community along entire reach through revegetation of native plants.

RIVER TERRACE RECOMMENDATIONS

Desired Future Conditions

The dense ponderosa pine and incense-cedar forest would be thinned to allow California black oak to grow in openings. Historic topography, floodplains, and channels would be restored and vegetated with native wetland and riparian vegetation. Non-native weeds such as Himalayan blackberry and cut-leaved blackberry (*Rubus laciniatus*) would be eradicated. Historic wetlands would be fully restored to their properly functioning condition, including their connectivity to meadows and wetlands outside the project area. All non-essential facilities would be removed. New trails would be constructed to provide visitors the opportunity to experience the restored river terrace ecosystem. Trails would connect to existing trails outside the restoration area. Scenic views of the Valley would be restored.

Pines Unit

- Restore ecological connectivity to the meadow near the Yosemite Concession Services stable, adjacent to the Pines Unit.
- Plan revegetation efforts using appropriate plant species, taking into account mapped root-rot areas, historic topography and channels, and near surface hydrology patterns.
- Revegetate through seeding, planting, mulching, and natural recruitment. Any seeding or planting will use locally collected or propagated native wetland and riparian species.
- Thin ponderosa pine, incense-cedar, and Douglas-fir trees, retaining the largest specimens. Prior to thinning activities, locate and mark all trees to remain on site. Retain all large snags where appropriate. Remove most sub-dominant trees, but maintain a varied age structure stand. Create openings sufficient to establish and maintain California black oak.
- Stockpile cut trees for future use as bioengineering materials, large woody debris, for other park projects, or for use by culturally associated American Indians.
- Remove all non-essential facilities and infrastructure including all asphalt, roads, and restrooms.
- Remove historic fills to reestablish historic topography, floodplains, and overflow channels.
- Remove old riprap and replace with riparian vegetation.
- Reestablish native shrub layer.
- Sow seed mix of site-collected native grasses and forbs.
- Design visitor use trails through the project site crossing Tenaya Creek.

Tenaya Unit

- Plan revegetation efforts using appropriate plant species, taking into account mapped root-rot areas, historic topography and channels, and near surface hydrology patterns.
- Restore native wetlands and establish ecological connectivity with existing meadow wetland near Royal Arches, located north of Tenaya Creek.
- Thin ponderosa pine, incense-cedar, and Douglas-fir trees, retaining the largest specimens. Prior to thinning activities, locate and mark all trees to remain on site. Retain all large snags where appropriate. Remove most sub-dominant trees, but maintain a varied age structure stand. Create openings sufficient to establish and maintain California black oak.
- Stockpile cut trees for future use as bioengineering materials, large woody debris, for other park projects, or for use by culturally associated American Indians.
- Remove all non-essential facilities and infrastructure including all asphalt, roads, and restrooms.
- Complete all soil excavations. Stockpile soil in approved locations.

- Remove and control non-native species such as Himalayan blackberry and cut-leaved blackberry.
- Establish deciduous woodland community along transition edge of wet meadow where Himalayan blackberry now dominates.
- Establish shrub layer consisting of Western azalea (Rhododendron occidentale) and other locally native shrub species.
- Sow seed mix of site-collected native grass and forbs.
- Design appropriate visitor use opportunities within this unit.

Stoneman Unit

- Plan revegetation efforts using appropriate plant species, taking into account mapped root-rot areas, historic topography and channels, and near surface hydrology patterns.
- Between Ahwahnee Bridge and Sugar Pine Bridge, remove the multi-use paved trail, which acts as a causeway that restricts natural water flow.
- Retain native fill material for use in rebuilding eroded riverbanks and cut-off channels.
- Design and build a new multi-use trail from the east end of Ahwahnee Bridge to Clark's Bridge through the unit. A temporary trail may be required to allow restoration activities to stabilize and cure before a permanent trail is constructed. Build trail to accommodate new/reestablished channels and seasonal flood events.
- Thin ponderosa pine, incense-cedar, and Douglas-fir trees, retaining the largest specimens. Prior to thinning activities, locate and mark all trees to remain on site. Retain all large snags where appropriate. Remove most sub-dominant trees, but maintain a varied age structure stand. Create openings sufficient to establish and maintain California black oak.
- Stockpile cut trees for future use as bioengineering materials, large woody debris, for other park projects, or for use by culturally associated American Indians.
- Complete grading to remove historic fills and restore complex overflow channels, topography, and flood conditions within the Merced River meander. Restore the main cut-off channel to its former width and depth.
- Establish ecological connectivity with Stoneman Meadow, which borders this unit to the south.
- Complete soil excavations to remove historic fills necessary to restore historic overflow channel(s) and wetland swale(s) in the remainder of the unit. Where possible, separate recent overwash from the underlying fill material. Stockpile underlying fill material in approved locations for use in river channel restoration.
- Remove all non-essential facilities and infrastructure including all asphalt, roads, and restrooms.
- Plant California black oak seedlings in openings. Plant deciduous riparian woodland in transition zone between California black oak woodland and riparian corridor zone.
- Sow seed mix of site-collected native grass and forbs.

Rivers Unit

- Plan revegetation efforts using appropriate plant species, taking into account mapped root-rot areas, historic topography and channels, and near surface hydrology patterns.
- Thin ponderosa pine, incense-cedar, and Douglas-fir trees, retaining the largest specimens. Prior to thinning activities, locate and mark all trees to remain on site. Retain all large snags where appropriate. Remove most sub-dominant trees, but maintain a varied age structure stand. Create openings sufficient to establish and maintain California black oak.
- Stockpile cut trees for future use as bioengineering materials, large woody debris, for other park projects, or for use by culturally associated American Indians.
- Remove all non-essential facilities and infrastructure, including all asphalt, roads, abandoned restrooms, and interpretive amphitheater.
- Complete soil excavations and groundwater/vegetation model. Restore historic overflow channel(s) and wetland swale(s). Where possible, separate recent overwash from the underlying fill material. Stockpile underlying fill material in approved locations for use in river channel restoration.
- Plant California black oak and big-leaf maple in openings.
- Establish deciduous riparian woodland and native wetland species in historic high-flow channels and wetland swales.
- Restore and enhance existing and historic wetlands.
- Sow seed mix of site-collected native grass and forbs.

Housekeeping Unit

- Plan revegetation efforts using appropriate plant species, taking into account mapped root-rot areas, historic topography and channels, and near surface hydrology patterns.
- Restore wetland at west end of unit following the installation of utilities that will cross the river at this location.
- Remove all non-essential facilities and infrastructure, including the removal of cabins within the River Protection Overlay as called for in the Yosemite Valley Plan.
- Thin ponderosa pine, incense-cedar, and Douglas-fir trees, retaining the largest specimens. Prior to thinning activities, locate and mark all trees to remain on site. Retain all large snags where appropriate. Remove most sub-dominant trees, but maintain a varied age structure stand. Create openings sufficient to establish and maintain California black oak.
- Complete all soil excavations to restore historic overflow channel(s) and wetland swale(s). Where possible, separate recent overwash from the underlying fill material. Stockpile underlying fill material in approved locations for use in river channel restoration.
- Establish a riparian deciduous woodland within this unit.
- Sow seed mix of site-collected native grasses and forbs.

SCHEDULE

A summary schedule, which shows when major tasks would begin, is provided in Table 3. Certain tasks such as maintenance and monitoring will be on-going and conducted annually for many years. For clarity, those types of tasks were omitted from the project schedule below. This is a 7-year schedule, but implementation will rely on the timing and coordination of other *Yosemite Valley Plan* projects, such as the removal of utilities and roads. These initial actions include a hydrologists' workshop, resolving permitting issues for removal of Sugar Pine Bridge, initiating the NEPA process, and finalizing the restoration design. Actual dates for implementing specific actions are contingent on securing necessary funding.

The schedule reflects an approach to begin major river reach work at the most upstream portions of the project area, recognizing that upstream manipulations will affect and influence subsequent downstream work. Portions of terrace work can be done farther downstream until final linkages between the river and terraces are made.

Table 3. Summary Restoration Schedule

Year	Action
1	Conduct hydrologists' workshop
	Complete NEPA and Restoration Design
	Complete Sugar Pine Bridge removal permitting
	Develop groundwater/vegetation model
	Establish baseline monitoring
2	Remove Sugar Pine Bridge and approach road
	Begin Stoneman Terrace Unit
	Begin Rivers Terrace Unit
	Begin Clark's Bridge Reach
3	Complete Stoneman Terrace Unit
	Complete Rivers Terrace Unit
	Complete Clark's Bridge Reach
	Begin Ahwahnee Reach
4	Begin Tenaya Terrace Unit
	Complete Ahwahnee Reach
	Begin Stoneman Reach
	Begin Tenaya Reach
5	Begin Housekeeping Bridge Reach
	Complete Stoneman Reach
	Complete Tenaya Terrace Unit
	Complete Tenaya Reach
	Begin Pines Terrace Unit
6	Complete Housekeeping Bridge Reach
	Complete Pines Terrace Unit
	Begin Housekeeping Camp Terrace Unit
7	Complete Housekeeping Camp Terrace Unit
	Gather monitoring data

MONITORING

A comprehensive monitoring plan will be implemented for this project. The monitoring program will center on three basic tenets: documenting baseline conditions prior to project implementation; evaluating the performance of specific project actions; and analyzing trends at various spatial and temporal scales.

A select group of geophysical and biological parameters will be monitored. These include river mechanics, vegetation, avian use, water quality, soil, and aquatic invertebrate populations. Reference sites for each of these features will be located and monitored. These parameters were chosen because, when taken as a whole, they provide a comprehensive accounting of the effects on the physical and biotic environment.

Monitoring will track specific project actions to determine success in restoring river mechanics and vegetation communities to their properly functioning conditions. Trend analysis monitoring will be done to analyze temporal effects of actions on both target and non-target parameters. For example, change in avian communities is not a specific goal or objective of any particular action. However, the combined effects of proposed actions may substantively change avian use. The response of avian populations to project actions may be studied to determine effects on related aspects of the environment, such as water quality and fish populations.

The monitoring design and protocols must allow for valid statistical analysis of results. The appropriate analysis tool will be documented in the final monitoring plan.

ADAPTIVE MANAGEMENT

The restoration actions proposed here have been developed from the current state of knowledge. Ecosystem managers acknowledge that a complete understanding of all aspects of ecosystem dynamics and restoration can never be attained. New knowledge will bring to light additional ecosystem relationships and dynamics, or new restoration technologies and techniques will be developed that have not been previously considered. The need for future revisions to this plan is expressly acknowledged.

Adaptive management is the process of continually improving management policies and practices by incorporating the results of past actions and new knowledge. Adaptive management depends on thoughtful project implementation and continuous monitoring of project results. A thorough review of monitoring results must be completed to incorporate findings into future project design and implementation.

Monitoring review involves revisiting project goals and objectives and determining if they are being achieved. If they are not, a determination must be made that either the base assumptions were wrong, the restoration actions were implemented improperly, site conditions have changed, or the monitoring is faulty and may not be reporting results accurately. An adaptive management team will be assembled to review monitoring reports and make these determinations. The team will be comprised of the Ecological Restoration Program Manager, Vegetation Ecologist, Hydrologist, Wildlife Biologist, Aquatic Biologist, Park Forester, Cultural Resources Representative, American Indian Council of Mariposa County, Inc., (also known as The Southern Sierra Miwuk Nation), Prescribed Fire Manager, and Landscape Architect.

Adaptive management involves six steps, including:

- Documenting the problem, the desired future conditions, and goals and objectives used to determine success;
- Developing a plan to achieve the desired future conditions;
- Developing a monitoring plan to gauge if goals and objectives are being met;

- Implementing the project;
- Monitoring and evaluating the success of the project based on achieving the desired future conditions and project goals and objectives;
- Adjusting the original plan based on the lessons learned.

The adaptive management plan allows for feedback and adjustments to the steps described above. The results of the monitoring may make it clear that the desired future conditions are unobtainable, the objectives are the wrong measures of success, the monitoring plan is measuring the wrong environmental elements, or the monitoring is not sensitive enough to uncover trends. Adjustments can be made to any elements of the plan.

THE NEPA PROCESS

The National Park Service is conducting a National Environmental Policy Act (NEPA) process for the Ecological Restoration and Visitor Experience project. The project was open for public scoping from April 4 through May 4, 2003. Twenty-five letters, faxes, and e-mails were received presenting various issues and concerns regarding the project (Appendix D). The National Park Service is currently in the process of comment evaluation. These comments will be used to help develop a full range of alternatives in the NEPA document and ensure important issues are disclosed and evaluated.

PERMITS/REGULATORY APPROVALS

Most, if not all, planned actions fall within the framework, guidelines, and proposed actions contained in National Environmental Policy Act (NEPA) planning documents completed in 2000 (*Yosemite Valley Plan, Merced Wild and Scenic River Comprehensive Management Plan*). Should proposed actions extend beyond the areas identified in these approved plans, involve an appreciable change in function and capacity, or if previously unknown resources are discovered during the design phase, additional NEPA compliance may be necessary.

Specific actions described herein may require the following reviews and/or approvals, to be determined when design reaches the point where compliance determinations can be made.

- Wild and Scenic Rivers Act Section 7 determination
- Clean Water Act Section 404 Permit(s) for in-water fills
- Clean Water Act Section 402 National Pollutant Discharge Elimination System (NPDES) permit
- National Historic Preservation Act clearance
- River Protection Overlay evaluation
- NPS Floodplain or Wetland Statement of Findings
- California Water Quality Control Board Section 401 Certification (in-water work)
- Endangered Species Act consultation

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- Christal Niederer, Biological Science Technician
- Kent van Wagtendonk, GIS specialist

David Evans and Associates, Inc.

- Dan Heagerty, Project Manager
- Kevin O'Hara, Senior Ecologist
- Scott Banker, Landscape Architect, Bioengineering Specialist
- Leslie Anderson, Graphics Designer, Word Processing

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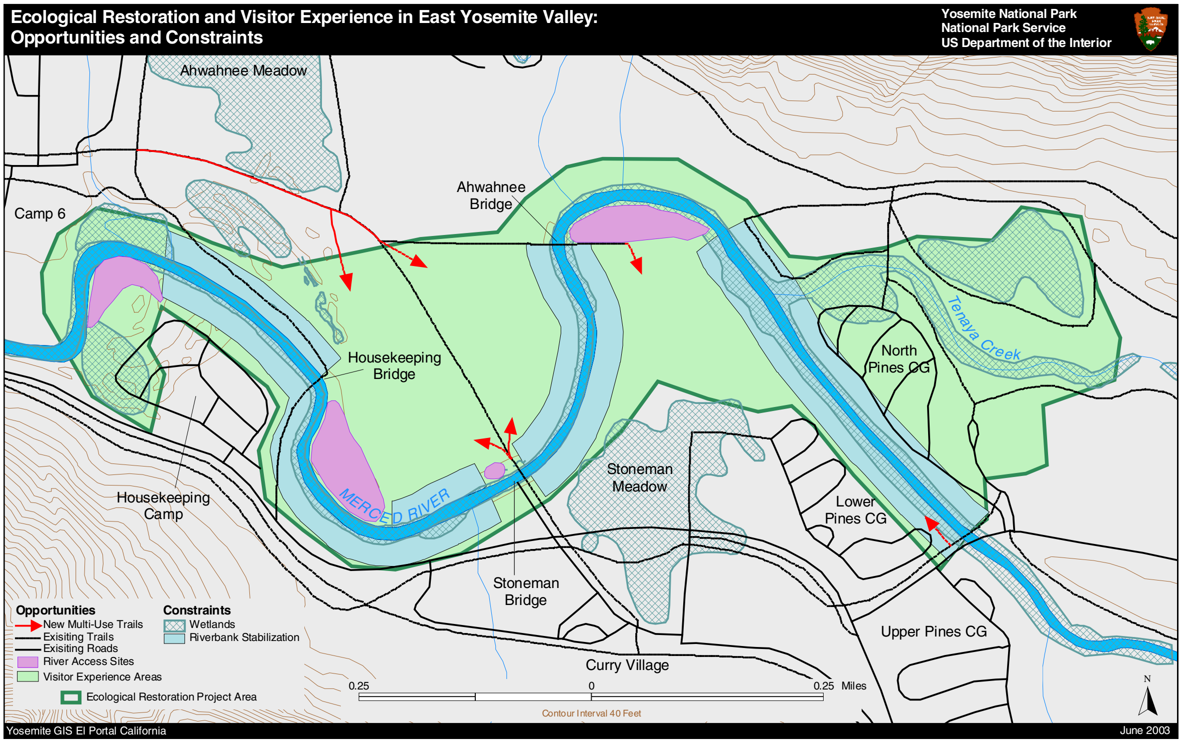
APPENDIX A: MAPS


Ecological Restoration and Visitor Experience in East Yosemite Valley:
Opportunities and Constraints
Yosemite National Park
National Park Service
US Department of the Interior
Ahwahnee Meadow
Camp 6
Ahwahnee Bridge
Housekeeping Bridge
North Pines CG
Tenaya Creek
Stoneman Meadow
Lower Pines CG
Housekeeping Camp
MERCED RIVER
Stoneman Bridge
Upper Pines CG
Curry Village
Opportunities
New Multi-Use Trails
Exisiting Trails
Exisiting Roads
River Access Sites
Visitor Experience Areas
Constraints
Wetlands
Riverbank Stabilization
Ecological Restoration Project Area
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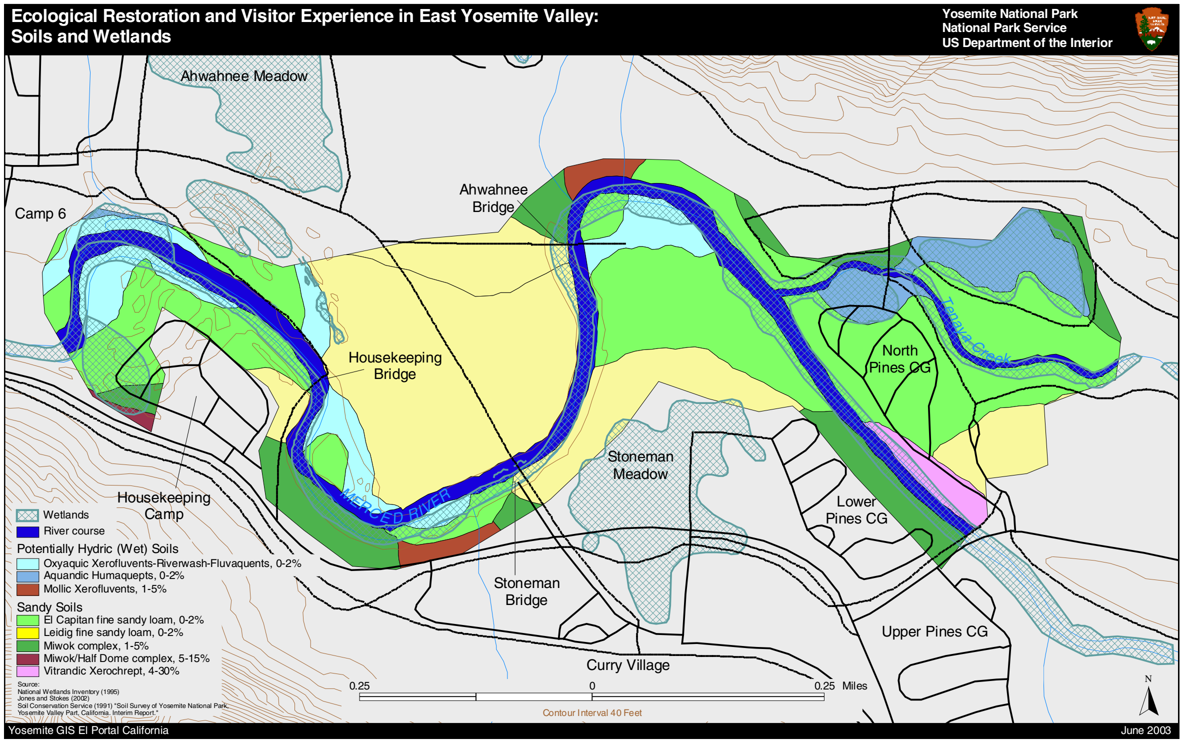
June 2003



Ecological Restoration and Visitor Experience in East Yosemite Valley:
Soils and Wetlands
Yosemite National Park
National Park Service
US Department of the Interior
Ahwahnee Meadow
Camp 6
Ahwahnee Bridge
Housekeeping Bridge
North Pines CG
Tenaya Creek
Stoneman Meadow
Lower Pines CG
Housekeeping Camp
MERCED RIVER
Stoneman Bridge
Upper Pines CG
Curry Village
Wetlands
River course
Potentially Hydric (Wet) Soils
Oxyaquic Xerofluvents-Riverwash-Fluvaquents, 0-2%
Aquandic Humaquepts, 0-2%
Mollic Xerofluvents, 1-5%
Sandy Soils
El Capitan fine sandy loam, 0-2%
Leidig fine sandy loam, 0-2%
Miwok complex, 1-5%
Miwok/Half Dome complex, 5-15%
Vitrandic Xerochrept, 4-30%
Source:
National Wetlands Inventory (1995)
Jones and Stokes (2002)
Soil Conservation Service (1991) "Soil Survey of Yosemite National Park, Yosemite Valley Part, California. Interim Report."
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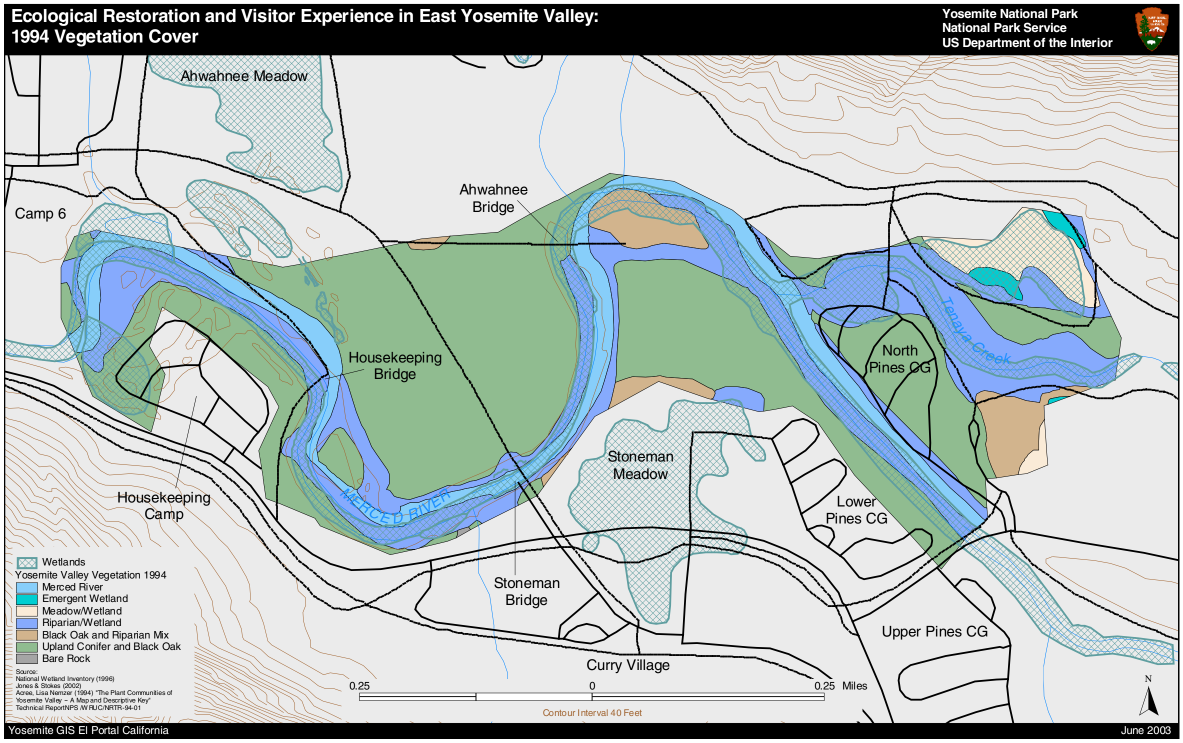
Yosemite GIS El Portal California
June 2003


Ecological Restoration and Visitor Experience in East Yosemite Valley:
1994 Vegetation Cover
Yosemite National Park
National Park Service
US Department of the Interior
Ahwahnee Meadow
Camp 6
Ahwahnee Bridge
Housekeeping Bridge
North Pines CG
Tenaya Creek
Stoneman Meadow
Housekeeping Camp
MERCED RIVER
Lower Pines CG
Stoneman Bridge
Upper Pines CG
Curry Village
Wetlands
Yosemite Valley Vegetation 1994
Merced River
Emergent Wetland
Meadow/Wetland
Riparian/Wetland
Black Oak and Riparian Mix
Upland Conifer and Black Oak
Bare Rock
Source:
National Wetland Inventory (1996)
Jones & Stokes (2002)
Acree, Lisa Nemzer (1994) "The Plant Communities of Yosemite Valley – A Map and Descriptive Key"
Technical ReportNPS /WRUC/NRTR-94-01
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Yosemite GIS El Portal California
June 2003

APPENDIX B: OUTSTANDINGLY REMARKABLE VALUES

Outstandingly remarkable values for the reach of the Merced River flowing through the project site (*Merced Wild and Scenic River Comprehensive Management Plan*).

Scenic – This segment provides magnificent views from the river and its banks of waterfalls (Nevada, Vernal, Illilouette, Yosemite, Sentinel, Ribbon, Bridalveil, and Silver Strand), rock cliffs (Half Dome, North Dome/Washington Column, Glacier Point, Yosemite Point/Lost Arrow Spire, Sentinel Rock, Three Brothers, Cathedral Rock, and El Capitan), and meadows (Stoneman, Ahwahnee, Cook's, Sentinel, Leidig, El Capitan, and Bridalveil). There is a scenic interface of river, rock, meadow, and forest throughout the segment.

Geologic processes/conditions – This segment contains a classic, glaciated, U-shaped valley, providing important examples of a mature meandering river; hanging valleys such as Yosemite and Bridalveil Creeks; and evidence of glaciation (e.g., moraines below El Capitan and Bridalveil Meadows).

Recreation – This segment offers opportunities to experience a spectrum of river-related recreational activities, from nature study and sightseeing to hiking. Yosemite Valley is one of the premier outdoor recreation areas in the world.

Biological – Riparian areas and low-elevation meadows are the most productive communities in Yosemite Valley. The high quality and large extent of riparian, wetland, an other riverine areas provide rich habitat for a diversity of river-related species, including special-status species, neotropical migrant songbirds, and numerous bat species.

Cultural – This segment contains evidence of thousands of years of human occupation reflected in a large number of archeological sites and continuing traditional use today. Nationally significant historic resources are found here, such as designated landscapes and developed areas, historic buildings, and circulation systems (trails, roads, and bridges) that provide visitor access to the sublime views of natural features that are culturally valuable.

Hydrologic Processes – This segment is characterized by a meandering river, world-renowned waterfalls, an active flood regime, oxbows, unique wetlands, and fluvial processes.

Scientific – This segment of the river corridor constitutes a highly significant scientific resource because the river watershed is largely within designated Wilderness in Yosemite National Park.

APPENDIX C: WORKSHOP REPORT - ECOLOGICAL RESTORATION OF FLOODED CAMPGROUNDS

Colonial Room, The Ahwahnee

Yosemite National Park

November 13-14, 2002

November 13, 2002

I. Participant Introduction

II. Project Introduction and Guiding Documents

A. Russell Galipeau, NPS - Discussed mission statement.

- Gave brief introduction to *Yosemite Valley Plan* and philosophy of ecological restoration
- Spoke about imperative to establish monitoring and performance evaluation for restoration projects

B. Sue Fritzke, NPS- Discussed General Management Plan, Merced River Plan and Yosemite Valley Plan in depth, framing the purpose and intent of the workshop

III. Dan Heagerty, DEA- Outlined the anticipated deliverables for the conclusion of the workshop

- Key Issues and/or Challenges
  - -Natural
  - -Artificial or human-imposed
- Technical Status by subject-area
  - -What we know
  - -What we'd like to know
  - -What we must know
- Topic Integration Requirements
- Steps required to concept plan (building blocks)
- Steps (anticipated) to implement (construction)

IV. Historic and 1997 flood background

A. Sue Beatty, NPS - Presented history of land management in Yosemite Valley

- This presentation facilitated discussion on the era/conditions to which the area should be restored.

B. Discussion of balance between ecological restoration and preservation of cultural resources.

- Laura Kirn, NPS, spoke about need to recognize and preserve the archeological, cultural and Native American significance of Yosemite Valley. Restoration actions must incorporate these considerations and needs.
- Sam Traina, UC-Merced, stated that restoration needs to take into account climate changes projected over the next 50 years. (Recent estimates indicate a 75% decline in snow pack over next 50 years due to global warming)
- Pam Benjamin, NPS, noted that she doesn't feel it's possible to restore Valley to pre-Euro American contact because of the extent to which the landscape has changed.

C. Group viewed series of maps and photos of the park.

- 1997 Flood Extent
- Vegetation Communities, Eastern Yosemite Valley (EYV)
- National Wetlands Inventory, EYV
- Major Soils, EYV
- *Yosemite Valley Plan,* EYV
- Photos of features of the project study area
- Historic photos
- 1919 map of Rivers Campgrounds and Lower Pines Campground
- Current map of ordinary high water mark in Rivers and Lower Pines Campgrounds
- Aerial photos, 1997 of eastern Valley
- Map of study area with infrastructure
- Map of utilities for East Valley campgrounds
- 1934 USGS map of Valley

V. Channel Morphology Monitoring

A. Marie Denn, NPS – presented data on channel morphology of the Merced River over the last 80 years.

1. Current river channel width above bridge vs. at bridge
   - 118' vs. 69' Clark's Bridge
   - 187' vs. 98' Sugar Pine Bridge
   - 162' vs. 120' Ahwahnee Bridge
   - 163' vs. 88' Stoneman Bridge
2. Sugar Pine Bridge slated for removal in *Yosemite Valley Plan,* Stoneman Bridge tentatively slated for removal.
3. Marianne Madej, 1991 study found that river channel widened by as much as 50' between 1919 and 1986 between Clark's Bridge and Sugar Pine Bridge and by as much as 80' between Ahwahnee Bridge and Stoneman Bridge.

B. Marie Denn presented data from last 10 years at 5 different river sections. She distributed a map showing the cross sections.

1. Current channel monitoring cross sections are approximately 300' wide, which encompasses most of River Protection Overlay but not 100-year flood plain. Cross sections include elevations for the entire length.
2. Segment downstream of Clark's Bridge
   a) Madej attributed widening of this section to pedestrian access from campgrounds on each side of the river, denuding and flattening slopes of banks.

b) All sections changed from the 1997 flood:

- Cross sections 10 and 11 had large scours
- Cross sections 12 and 13 have large amounts of sedimentation

3. Segment between Sugar Pine and Ahwahnee Bridges has a large amount of bank armor and hasn't changed greatly from 1919 map.
   - Cross sections 16-18 are currently very stable because of bank hardening (riprap on right bank)
4. Segment between Ahwahnee and Stoneman Bridges had a large amount of bank widening between 1919 and 1986 study.
   - This is partially due to bank hardening in previous segment and to channeling of water into one overflow channel that empties below Ahwahnee Bridge.
   - Segment has also eroded because of campgrounds on each side. It is also possible that the left bank is being used as a "brake pad" as water comes through Ahwahnee Bridge.
   - Segment erosion is also due to campgrounds and visitor trampling.

VI. Project constraints and future status

A. Sue Fritzke, NPS, presented current infrastructure and utilities in project study area.

B. Jeff Harsha, NPS, discussed existing utilities in more depth.

- NPS is creating a master plan for removal of as many utility lines as possible from the Valley, with a goal of creating utility corridors for all lines.
- Utility relocation will occur in stages over next eight years.
- Storm water drainage is localized, no detention or treatment occurs in park.
- This workshop should consider whether to leave abandoned utility lines in ground or remove them.

VII. Soil borings at Upper and Lower River Campgrounds and Ordinary High Water (OHW)

A. Joel Butterworth, Jones and Stokes - presented map showing OHW mark

B. Joel presented his findings from 90 recent soil borings intended to determine depth of imported fill in campgrounds.

- He was not very successful in finding location of channels from the 1919 map that emptied into Merced River.
- It is unclear how much fill exists and whether it covers the entire campgrounds area. The area is a floodplain with large amounts of naturally imported material, which makes fill material difficult to identify.
- He identified 20" – 40" of soil in former swale areas that he feels confident is fill.
- He noted that the existing soils map, in the informational packet distributed to workshop participants, is incorrect regarding some soil types.

VIII. The group walked through the Lower Pines and Upper and Lower River Campgrounds.

The following existing and desired conditions were observed and discussed:

- Bridges
- River channel and banks
- Tree species and densities

- Annosus and *Armillaria*
- Assumed previous ecological system in area (i.e. wet or dry meadow, oak woodland)
- Infrastructure
- Soil borings

IX. Project Goals and Objectives Brainstorming

A. The group spent 45 minutes stating goals and objectives for the restoration. Snow cards were used to record all ideas. The snow cards were later grouped into categories and used to define the breakout groups for Day 2. The group also discussed the project in terms of project duration and monitoring cycles.

B. The group was asked to consider the following items during the brainstorming session:

- How long will the project last?
- When does the project transition from restoration to maintenance?
- When has the project achieved large-scale physical goals that will instigate the remainder of the restoration? What is 80% success?
- How long will it take to utilize the first phase of project funding?
- What are the desired future conditions?
- Will restoration be “natural” or “artificial” and what are the implications of those choices on project duration?
- Do we establish different planning horizons for different processes?

November 14, 2002

Revised Agenda

8:40-8:50	New Issues
8:50-9:00	Group Explanation
9:00-9:30	Topics to Consider
9:30-9:45	Group Formation
9:45-10:00	Break
10:00-12:00	Breakout Groups
12:00-1:00	Lunch and Group Presentations
1:00-1:30	Synchronize Goals
1:30-1:45	Group Instruction
1:45-2:00	Break
2:00-3:15	Breakout Groups
3:15-4:00	Group Presentations
4:00-5:00	Integration of Results

I. New Issues

- Participants added several additional goals and objectives to those generated on Day

II. Breakout Group Topics

A. Dan Heagerty, DEA explained that the issues and goals generated on Day 1 were grouped into topic areas by project staff. These topic areas were then used to create five breakout groups: overall design criteria, hydrology and river mechanics, soils and topography, habitat (plants and wildlife), and treatment objectives.

B. Sue Fritzke, NPS discussed key goals and objectives (from Day 1 brainstorming session) for each topic area.

1. Design Criteria
    a) Phasing of infrastructure removal and replacement
    b) Relationships to other projects
    c) Monitoring
    d) Sustainability
        - Reuse of materials
        - Self-sustaining/low maintenance
    e) Visitor enjoyment
        - Resources and scenery/vistas
    f) Interpretation, education and partnerships
    g) Reminders – special conditions
    h) Compliance
2. Hydrology/River Mechanics
    a) Restore pre-alteration morphology
    b) Restore surface/subsurface flows
    c) Enhance floodplain/upland connections
    d) Reconnect cliff-face runoff to meadows
    e) Restore overflow channels
    f) Restore/maintain landscape level connectivity
    g) Improve in-channel ecology
3. Soils and Topography
    a) Restore prehistoric topography
    b) Define soil and topographic requirements for ecological function
    c) Restore soil processes for ecological function
    d) Soil restoration for vegetation restoration
4. Plants
    a) Control invasive nonnative plants
    b) Maintain some trees
    c) Education about tree removal in relation to ecosystem improvement

d) Oak regeneration

e) Restore riparian structural diversity

f) Increase/maintain culturally important species

g) Maintain community level biodiversity

h) Maximize species diversity and structural compatibility

i) Needs

- Current/historical seed bank
- Role of pioneer species
- Stand densities by species
- Understand historical vegetation
- Consultation with tribes (tree removal and use)
- Monitoring

5. Wildlife

a) Increase species/community diversity

b) Improve wildlife habitat

c) Structural complexity

d) Eliminate nonnative species

e) Develop/maintain wildlife corridors

f) Investigate invertebrates

g) Evaluate feasibility of reintroducing species

h) Remember! Avoid habitat disturbance during breeding season

6. Treatment Objectives

a) Restore Natural:

- Processes
- Topography
- Riparian Areas

b) In-stream woody material

c) Reintroduce cultural practices

d) What do we do on a project level to meet restoration goals?

7. Monitoring and Assessment (Each group was asked to consider monitoring and assessment needs specific to its focus.)

a) Overall concerns

- Ability to measure change
- Continual incorporation into project management
- Public acceptance evaluation

b) Habitats

- Characterize/quantify reference site(s)
- Plant and wildlife responses, survival and viability

c) Physical Environment

- Air and water quality, temperature, flows and rainfall
- Morphology – river cross sections, in-channel woody debris
- Sediment flows and movement

III. Breakout Session 1:

A. Group assignments were given to each participant based primarily on participant's area of expertise.

B. Sue Fritzke, NPS presented the Highly Valued Resources from the *Yosemite Valley Plan*. She asked that groups consider the enhancement of Outstandingly Remarkable Values of the river, identified in the Merced River Plan.

C. Participants then broke into their individual groups to discuss the following items:

- Key Issues/Challenges
- Define Success

  - Desired conditions that lead to preferred outcomes
- Timeframe

  - Short Term

  - Long Term
- Required Interdependencies with Other Groups

IV. Breakout Session 1 Presentations

A. Overall Design Criteria - Steve Goldman

1. Ecological Sustainability

   Key Issue: Design self-sustaining ecosystem

   - Low maintenance (minimize exotics, stabilize riverbanks)
   - Resiliency (to floods, drought and other natural processes)
   - Ability to accommodate change

2. Sustainability: Design and Construction Aspect

   Key Issue: Balance project-generated and needed materials within the project area, Yosemite Valley and Yosemite National Park to minimize costs, impacts and waste

   - Historic structures
   - Minimize petrochemical use (material transport)
   - Fill materials
   - Wood/lumber/fences
   - Native American needs

3. Infrastructure

   Key issue: Minimize infrastructure in project area to facilitate natural processes and reduce need for facility maintenance

   - Restore river processes by removing Sugar Pine Bridge, river revetments and meadow manipulations and causeway
   - Co-locate multi-use path and Ahwahnee Hotel waterline
   - Remove abandoned roadways and causeway
   - Retain Ahwahnee Bridge and infrastructure necessary to protect and maintain it
   - Mitigate ongoing impacts to natural and cultural processes from abandoned utilities

4. Visitor use and enjoyment

   Key issue: Appropriate resource-based access is provided for visitor use and enjoyment

   - Trails keyed to resource opportunities (views, vistas, river, resource areas)
   - Minimize visitor use impacts
   - River access to point bars

5. Cultural Landscape (overall project "look")

   Key issue: Project design re-establishes, enhances and maintains defining characteristics of cultural landscape

   - Openness
   - Views and vistas
   - River/riparian corridor
   - Meadows
   - Historic circulation patterns

6. Interpretation, Education, Partnerships

   Key issue: Communication, collaboration, cooperation and opportunities for participation in planning, design and implementation (including monitoring/assessment) of ecological restoration with stakeholders

   - Public and other stakeholders aware of and understand project
   - Develop and implement communication strategy
   - Public school groups utilize the area
   - Minimize the number of basic questions (such as: What are you folks doing here during restoration?)
   - Partnerships established to accomplish different aspects of project development and implementation
   - Interpretation and education program
   - Publish results in scientific literature

B. Hydrology – Tom Smith

1. Key issues
   a) How do we get to narrower channel?
      - What is the target width-to-depth ratio?
   b) What is the target for overflow conditions/frequency?
   c) Groundwater and cliff-face runoff
2. Desired Processes/Conditions
   a) Meander system with natural confinements
   b) Restore historic (1919) narrowness to channel
   c) Restore ecological and structural functions to riparian areas
   d) Restore landscape connections of cliff-face runoff and overflow channels (removal of utilities is key)
3. Timeframe
   a) Short Term – 1-5 years
      - Riprap removal
      - Import and/or recycle soils and plant material to narrow channel
      - Monitor groundwater and cliff-face runoff
      - Possibly model runoff and groundwater
      - Ditch filling/culvert changes
      - Restore overflow conditions
      - Utilities abandonment/obliteration
      - Remove 1 – 2 bridges
   b) Long Term – 20-30 years
      - Remove more artificial impediments to runoff and groundwater movement
      - Keep building on past successful actions
      - Narrower channel is the target
      - Broad floodplain manipulation
   c) Interdependencies
      - Soils and topography
      - Plants
      - Exotic fish/wildlife

C. Soils and Topography – Sam Traina

1. Key Issues and Challenges
   a) Identify prehistoric conditions (topography and soil)

b) Determine accuracy of 1919 topo:

- Integrate inconsistencies between 1919 and current topos
- Identify any pre-1919 alterations
- Photo archive interpretations
- Pollen analysis
- Soil borings – analyze current findings
- Channel width and oxbow topography

c) Do alterations to adjacent sites still affect area?

- Are there still drainage ditches in Ahwahnee and Stoneman Meadows, etc.?

2. Define Success
   - Define or describe biochemical cycles (esp. nitrogen and carbon)
   - Measure organic carbon content
   - Assess ability to sustain target vegetation
   - Inventory microfauna and microflora
   - Restore pH (with burning?), Oxygen Reduction Potential (ORP) and conductivity
   - Are measurements approaching reference site?
3. Timeframe
   a) Short term – within 2 years
      - Reference site definition
      - Fill removal with archaeological sensitivity
      - Topographical restoration – more is better than less (See "Group Comments" below)
      - Causeway and bridge removal
      - Establish monitoring stations (including groundwater)
      - Tree removal (at least partial)
      - Broadcast burn

   b) Long term – 25 years
      - Attain target vegetation, including density
      - Attain "steady state" hydrologic condition of soils
      - Attain stable biochemical cycles
4. Required interdependencies
   a) Hydrology
      - Extent of hydrologic restoration corresponds to amount of topographic/soil restoration possible
      - Surface and groundwater modeling

b) Utilities and infrastructure removal/modification

c) Vegetation and wildlife

- Collaborate on target habitats
- Collaborate on monitoring and measuring success

5. Group Comments

- Increase potential for overland flow by lowering floodplain more than is needed (especially at overflow channel by bridges) to establish water flows, geomorphic features (channels), sediment, deposition.

D. Plants and Wildlife – Sacha Heath

1. Define success/desired conditions - plants and wildlife will be parameters of ultimate "success" of project

- Query historic conditions and similar existing sites between 3500 feet – 4500 feet

a) Get densities, cover; structural components for abundance by species by layer

- Black oak woodland, riparian woodlands, riparian willow scrub, wetland areas

b) Wildlife – aquatic and terrestrial

- Focal/guild species diversity by habitat type
- Community based
- Seasonality

c) Invertebrates

- Focal/guild species diversity by habitat type
- Complexity of trophic web
- ▪ Species richness and composition rank/abundance
- ▪ Biomass
- Total community analysis

d) Improve habitat for a host of species of concern and economic or culturally important species

- Control nonnative species

e) Maintain appropriate existing species within habitat improvements

f) Research historic conditions

- Bird/mammal data from early 1900s
- Photos of area; seed bank analysis; knowledge of resources at Native American villages

2. Preferred outcomes

a) Visitor/partner understanding of restored processes and human/animal interaction

b) Net increase in critical habitat for oak woodland, riparian willow scrub and wetlands

c) Resilience (e.g. native species competition with nonnative, human use, flooding, traditional collection of economic plants, use management, species viability)

d) Incorporation of traditional ecological knowledge

e) Enhancing wild and scenic river components

3. Timeframe – Short and Long Term

a) Short and long term on-the-ground intervention

1) Restoration and tree thinning in spatial and temporal phased zones

2) Add in-stream woody material to river, revegetate bank and stabilize thinning along riparian corridors

3) Revegetate with grasses, shrubs, oaks and thinning in black oak woodland

4) Upland areas thinned more slowly

5) 3 - 5 years for riparian/river restoration

6) 3 - 10 years for wetland restoration in existing wetland areas (refer to recent wetland delineation)

7) 3 - 20 years for black oak woodland restoration

- Thinning would include retaining diseased trees for snag production

b) Monitoring = 0-30 years

- intensive at beginning and less frequent at end

1) Species viability- nest success/productivity

2) Develop parameters for desired conditions, which will be used for monitoring.

3) Nonnative species

4) Spatial and temporal variability

4. Interdependencies

a) Hydrology

b) Visitor use

- Appropriate access
- Interpretation

c) Cooperation with gathering plan

d) Sustainability (e.g. thinned tree use for historic and restoration projects)

e) Diseased trees for snag production

f) Soils and topography

- Determine spatial areas for restoration

g) Treatments

- Fire use for oak woodland maintenance
- Restoration techniques to achieve goals
- Nonnative species eradication

- Hydrologic restoration

5. Group Comments

   h) Equality of historic use over time

   i) Use Native American materials, such as feathers from specific areas, to determine historic species

E. Treatment Objectives – Kara Paintner

1. Key issues/challenges

   a) Remove prescribed trees

   b) Remove/mitigate infrastructure

   c) Implement topographical and soil prescriptions

   d) Understory vegetation manipulation – include Native American input

   e) Restore fire and flooding as processes

   f) Exotic plant management

   g) Implement hydrologic/riverine prescription

2. Define Success

   a) Have the Outstandingly Remarkable Values (ORVs) been enhanced?

   b) Are we using minimum requirement and minimum tool within prescribed timeframe where we have information?

   c) Where we don't have information to determine minimum requirement/minimum tool, are we using adaptive management/experimentation ?

      - Full range of traits?
      - Monitoring/detecting differences?

   d) Mitigate or litigate?

      - Must create public understanding

   e) Do natural and cultural processes have the opportunity to occur?

3. Timeframe – desired timeframe will determine the minimum tool. For example:

   a) Conifer removal : chainsaw vs. fungus

      - 1 year vs. 30 years

   b) Building banks (engineering historic channel) vs. stabilization/aggregation

      - 3-4 years vs. decades? 100+years?

   c) Planting vs. natural revegetation

   d) Phased vs. large scale removal of trees and fill

4. Required interdependencies with other groups

   a) What is target condition?

   b) What is target timeframe?

   c) What is physically, economically and politically feasible?

   d) Prioritize conflicting objectives?

V. Synchronizing Goals and Desired Outcomes

The group discussed the presentations in an effort to synchronize goals and clarify group objectives and desired outcomes for the restoration.

A. How do you reconcile need for scientifically defensible process vs. adaptive management?

A. Which processes are/are not self-sustaining?

B. Need to restore process and structure simultaneously

C. Hyper-lowering the floodplain

- Removed fill and trees can help build river banks
- Removal of trees will help raise the water table
- Dispute over previous condition of floodplain because: wetland or oak woodland?
- This may require additional compliance.

D. What are we restoring site to?

- Restored area will change over time as natural processes evolve/change
- Disagreement about when/what to restore to
- Do not put too much importance into 1919 map and historical photos
- Shouldn't set a "steady state" goal; it will be a dynamic system
- Define functions and performance criteria of desired system.
- Note that this is a conjectural restoration: sites are not being restored to a specific period or condition in time, but rather to a general assumption of conditions prior to the 1919 alterations.
- Create "new" appropriate conditions
- Potentially do more soil investigation with backhoe trenching, etc.
- Cross-sectional trenching to investigate buried soil horizons
- Excavate to A horizons – weed seed concern from exposing buried seed banks

E. Is there a target, reference site we can reference to?

- Don't want to keep doing what we've been doing just in case we are going on the wrong path
- Need to look outside of Yosemite to get example sites

  - Tenaya Canyon may have potential for reference site(s).

F. Seed Bank Discussion – Buried seed may be completely different from existing vegetation

VI. Breakout Session 2 – Participants broke into their groups to discuss the following items:

A. Concept Plan

- Define functions and performance criteria of desired system

B. Construction requirements and considerations

- Steps to implementation, specifically within next 5 years

C. Monitoring and assessment

VII. Breakout Session 2

A. Overall Design Criteria – Brenda Ostrom

1. Sustainability/Balance
    - Calculate removal amounts (vegetation – trees, hydrological system and topography)
    - Calculate material needs in project, in Valley, and in park for total project list and future projects
2. Sustainability/Ecological
    - Monitor and assess vegetation, soils, hydrological system and stream banks
3. Minimize infrastructure
    a) Remove Sugar Pine Bridge –year 1, follows compliance documents
    b) Cultural landscape nomination for Yosemite Valley
    c) Remove campground asphalt – year 1
    d) Remove abandoned utilities – depends on topography
    e) Remove causeway
    f) Remove Northside Drive
    g) Archeological testing and mitigation – year 1 on
    h) Relocate utilities (utility master plan project)
    i) Remove trees – concurrent with planning and during vegetation manipulation and thinning
4. Positive/desired visitor experience
    a) Big views
    b) Locate trails in open locations
    c) View of Royal Arches and Washington Column from project area and visitor access to those views
    d) Photo points for views/vistas
    e) Mosaic of experiences
    f) VERP- Visitor Experience and Resource Protection
    g) Partner feedback (Native Americans) - horticultural practices
    h) Provide access to area via trails and river access (construct immediately after topographic manipulation and utility placement)
        - Bathrooms? Utilities?
5. Awareness and understanding
    a) Develop communication strategy
    b) Year 1
        - Identify all stakeholders
        - Meet with stakeholders
        - Develop interpretation plan

- Determine message and best media
- Develop partnerships

c) Year 2 on

- Develop education program
- Publish papers (scientific)/presentations
- Number of programs
- Visitor counts
- Open house contacts
- Count numbers, surveys, feedback and comments (park wide)

B. Hydrology – Sean Eagan

1. Desired system

a) Meandering river

b) System with primarily natural (not artificial) confinements and natural geomorphic character

c) Appropriate width and width/depth ratio

d) Floodplain connectivity, narrower channel conditions

e) More complex in-stream and riparian structure

f) Natural (restored) sheet flow over Valley rim, surface flow and groundwater recharge system

g) Restore ecological and structural functions of riparian areas

2. Performance Criteria

a) Improvement of width/depth ratio

b) More natural frequency of over-bank flooding

c) Increased densities and total surface areas of complex structure (in-stream and riparian)

d) Turbidity levels at project and downstream will be minimal change from upstream

e) Cooler water temperatures post–project at low-flow times

f) Reduce the (maximum) amount of impediments to natural groundwater and wall water distribution

3. Steps for Implementation – Next 5 years

a) Remove Sugar Pine Bridge and elevated roadbed/approach

- Remove all riprap above Sugar Pine Bridge – some below

b) Restore/enhance cliff-face runoff distribution

c) Fix/fill cut-off channel at Sugar Pine Bridge

d) Narrow the channel between Clark's and Sugar Pine Bridges

e) Install gauge on Tenaya Creek

f) Place monitoring wells for cliff-face runoff mapping

g) Begin removal/collapsing of pipes throughout protected area

h) Remove Northside Drive between Stoneman Bridge and Yosemite Village

4. Monitoring and Assessment

a) In-stream riparian densities/structure/frequencies

b) Find reference sites if possible

c) Groundwater monitoring, then flow/distribution mapping

d) Invertebrate communities inventory

e) Turbidity and temperature monitoring

5. Participants noted that park should collect reference data on existing conditions now for Tenaya and Merced, so have reference for future monitoring

- Work on Tenaya Creek should be performed within first five years of project, so work can progress from upstream through downstream areas.
- Above Clark's Bridge, left, there is non-functional riprap

C. Soils and Topography – Sam Traina

1. Function and Performance

Goal: Suitable soil habitat resilient to natural events

a) Supports target vegetation sustainably

- Carbon accumulation in soil

b) Deposition of new overwash

- Erosion of soil (balance with deposition)

c) Depth of groundwater over elevational gradient; April - September

- Extent of duration of flooding/ponding

d) Biochemical assessments (nitrogen, carbon, etc.)

e) Healthy microflora and fauna populations

2. 5 Year Construction Requirements and Considerations

a) Phase work so previous work is undamaged (remove trees before removing fill, etc.)

b) Use removed materials on site

- Remember not all fill is identical, so use wisely

c) Use archeological sensitivity when moving earth

d) Seed bank – retain natives, contain invasives

e) Contain pathogens

f) Import soil inoculated with appropriate mychorrizae (native fungi gathering and plant health)

g) Test for pH adjustment requirement before manipulation to determine timing of burn

h) Install groundwater wells

3. Monitoring and Assessment
    a) Onsite weather, especially precipitation (use portable agroclimatic weather monitor?)
    b) Soil temperature and pH
    c) Integrate with vegetation monitoring team
4. Other group comments
    a) See function and performance criteria
    b) Can use old piles of fire ash from other parts of park if soil needs pH raised.
    c) Assessment of microclimatology in Valley before installation of weather station
        - Have weather station that can monitor soil temperature and moisture.
            - It is mobile and can move where needed.

          Goal – largely replicate topography of 1919 map, for lack of better reference point.

D. Habitat – Sacha Heath
1. Define Function
    a) Reproduction/recruitment
    b) Decomposition/nutrient cycling
    c) Productivity (1° and 2°)
    d) Connectivity (e.g. dispersal corridors)
    e) Soft edges between habitats
    f) Shading/cover
    g) Resiliency/dynamic systems (after cultural/natural disturbance)
    h) Trophic complexity
    i) Food and material production
    j) Sediment retention
    k) Nutrient and propagules transport/distribution
    l) Composition
2. Performance criteria
    a) Within range of variability for reference conditions
    b) For vegetation:
        - Age class distribution
        - Plant vigor (reproduction, productivity, recruitment)
        - Presence of microsites for germination and/or for rare species establishment
        - Spatial and structural heterogeneity
        - Composition

c) For wildlife:
   - Age class distribution
   - Viability (reproduction, recruitment and demographics)
   - Suitable breeding habitat
   - Microsites for rare species
   - Species richness, abundance, biomass and composition
   - Trophic complexity

3. Construction requirements and considerations
   a) Minimize barriers to provide connectivity
   b) Phase construction activities
   c) Salvage soil to protect seed bank, microflora, microfauna and mycorrhizae
   d) Clump distribution of planting (use minimal clump sizes for animal use)
   e) Salvage existing plants (appropriate genetic material)
   f) Clean equipment to minimize weed spread
   g) Minimize disturbance during breeding/hibernation (work during fall season)
   h) Do soil chemistry analysis
   i) Remove most cut stumps (may leave some for Annosus)
   j) Leave some cut woody material on site for nutrients, microsites and fire fuels
   k) Determine thinning prescription and wind-throw potential
   l) Retain or recruit snags

4. Monitoring and assessment
   a) Baseline data needs
   b) Photo documentation
   c) Groundwater monitoring
   d) Presence/absence of birds
   e) Presence/absence of mammals
   f) Cover of canopy
   g) Frequency of plants in vegetation layers (diversity)
   h) Invertebrate inventory and community composition priority for reference site
   i) Soil (bio components) and seed bank analysis
   j) Research prehistoric and historic vegetation (field notes, herbaria records, village sites ethnobotany)
   k) Monitoring during restoration
      - Continue baseline monitoring
      - Cultural/archeological survey/monitoring during construction
   l) Assess data vs. reference conditions
   m) Interpret results through reports and journal publications

5. Group Comments

   a) Spatial phasing: work on riparian areas first, if project is phased

      - Need to discuss phasing because groups disagree

   b) Experiment with small plots in every area.

      - Monitor over 1 year and then proceed with area that does best

   c) Need baseline information on animal species in area to help determine phasing strategy

      - Are there any species that can't be stressed or won't migrate easily to adjacent sites?

   d) Prioritize which trees come out and which stay – informed by topography

VIII. Summary and Integration

A. Need to accelerate some processes because of interdependencies and political acceptance, so that project maintains current momentum.

B. Removal of infrastructure does <u>not</u> need to move slowly. In the following order of priority:

   1. Remove Sugar Pine Bridge and causeway between the Sugar Pine and Ahwahnee Bridges. (Some objection to this because want modeling to establish baseline information first)

   2. Remove asphalt and abandoned utilities.

      - Aggressive control of exotics needed after asphalt removal
      - Thin trees (one time vs. multiple times?) and build banks
      - Coordinate with topographic manipulation to minimize impacts in the area.

   3. Remove infrastructure.

C. Have monitoring plan in place before start of restoration

   1. Need adequate baseline information

      a) Monitor migration of in-stream woody material

      b) Soil compaction bulk density measurements

D. Remember compliance requirements.

APPENDIX D: PUBLIC SCOPING SUMMARY

Ecological Restoration of Flood-Damaged Yosemite Valley Campgrounds

This report was developed from public comments received during the public scoping comment period for the Ecological Restoration and Visitor Experience of East Yosemite Valley report. Comments received during the formal public comment period consisted of 25 letters, emails, and faxes. The public scoping period took place from April 4, 2003 through May 4, 2003. These comments have begun to be analyzed using the National Park Service's adaptation of a process developed by the United States Department of Agriculture, Forest Service, Washington Office Ecosystem Management Staff, Content Analysis Team. The next step in the process is to screen concerns to identify substantive planning issues and assist in responding to the public concerns identified. In addition, the National Park Service will develop written responses to the concerns.

Planning Process and Policy

The National Park Service should allocate adequate money annually for facility maintenance.

- Infrastructure always needs to be maintained, is it because of lack of money to maintain and upgrade that costs are now so high? What else has the money been used for? (Individual, Midpines, CA, Comment #19-2)

The National Park Service should consider adding additional campsites at alternate locations outside Yosemite.

- Are there areas in the park that could be expanded into camping areas with the hybrid bus shuttling people to the valley regularly? (Individual, Grass Valley, CA, Comment #16-2)
- Next to the geologic features of the Valley like Half Dome and El Capitan, the Merced River is one of the most notable features of Yosemite Valley. More importantly, the natural flow of the river and the integrity of its ecosystem are paramount to the health of the Valley as a whole. For this reason, our organizations want to make clear that restoration of the areas known as Upper and Lower River Campgrounds and Lower Pine Campground should be paramount above rebuilding campgrounds that existed prior to the major flood event in January, 1997. If additional campsites are needed, they must be located outside Yosemite Valley. The former campground sites are unarguably located in the floodplain, and thus, any campground re-building or construction would place campsites in a location that assuredly will flood again. In fact, the Lower Pines, Upper & Lower Rivers Campground Report states that "[a]lthough the January 1997 flood was the largest on record for Yosemite Valley, floods events of similar or greater magnitude can be expected to occur in Yosemite Valley in the future (2002, EDAW Study). (Conservation Organization, Oakland, CA, Comment #14-2)
- To conclude on this point, National Parks Conservation Association, Natural Resources Defense Council and The Wilderness Society support an increase in camping opportunities within the park, outside Yosemite Valley. Additional campground facilities can either be provided outside the Valley through expansion of current campgrounds, or additional overnight facilities can be eventually created both inside and outside the Park in appropriate locations identified through separate environmental analysis. (Conservation Organization, Oakland, CA, Comment #14-4)

The National Park Service should consider year-round visitor numbers rather than just seasonally high visitor numbers during planning and development.

- Check the gate counts, the housecounts, the campground inventories, Yosemite is not always crowded. I'd not like to see any expensive permanent solution to seasonal inconveniences, it would do nothing for the visitor experience. I think the various turnouts and multiple parking areas are a great disbursement of visitors. Central parking areas in or out of the park are not only a waste of money and space, used for a short periods... They would not give visitors the diverse Yosemite experience that should be offered, and make a great impact on the location. Not every visitor to the park goes to a visitors center and channeling them all towards one is a lot of impact and congestion. (Individual, Midpines, CA, Comment #19-1)

- I believe that any decisions on how to restore these campgrounds should wait until after the outcome of the congressionally directed Parkwide Campground Study. I think 800 campsites in the valley is a good number. I do not believe the park has properly considered the additional impact of motel lodging. Campers require less employees than people staying in motels, for example - maids. The impact of each additional employee is very high. (Individual, Comment #11-1)

The National Park Service should reduce human impacts by limiting visitation.

- There is a demand to see the park but if you simply put a limit of visitors, you simply wouldn't need to serve so many! (Individual, San Leandro, CA, Comment #15-1)
- As a life long camper who wants to see Yosemite's human impact reduced, and [I] agree with reducing the number of campsites... I also feel that the preservation of the park could suffer from their goals of over building commercial entities at the park's gates, without limiting the number of people coming into the park on a daily basis. Though I think that in Yosemite there should be a reservation system for day-use, I also know that position has been shot down and is no longer on the table, unfortunately for the park. (Individual, Truckee, CA, Comment #24-1)

The National Park Service should rotate campgrounds.

- If a campground is in need of restoration, rotate it out for restoration, farmers rotate crops, ranchers rotate stock. If camping is down, all the better, don't fix something that people aren't over using. (Individual, Midpines, CA, Comment #19-4)

The National Park Service should lower entrance levels and waive entrance fees for campers.

- My other comment concerns the lack of progress of the many projects which the park entrance fee increases support. I think the entrance fee of $20 is too much. If the thinking is "making the fee high so not as many visitors will come" is the philosophy, then you are not serving the American public. I have not seen much progress, ie, "visible park improvements," since the entrance fee increase. I would like to see the entrance fee waived for campers who have already paid their campground fees. (Individual, San Ramon, CA, Comment #22-2)

Alternatives

The National Park Service should proceed with the restoration of the flood-damaged campgrounds.

- We are pleased to see the Park Service moving forward with this project as it represents it is the largest habitat restoration project of the Yosemite Valley Plan. Accordingly, it must not be delayed any longer, with actual restoration activities being initiated immediately following conclusion of restoration planning. (Conservation Organization, Oakland, CA, Comment #14-1)
- […] the Central Sierra Environmental Resource Center strongly urges the Park Service to move forward with proposed plans for ecologically restoring the Upper and Lower River Campground area and the portion of Lower Pines Campground under consideration for restoration. Alternative campground facilities can either be provided outside the Valley through expansion of current campground areas, or additional overnight facilities can be eventually created both inside and outside the Park in appropriate locations identified through separate environmental analysis. Thank you for your efforts to seek the appropriate balance between environmental and social pressures. We support the ecological restoration of the campground areas as the best management to meet the overall public need and visitors' expectations. Yosemite Valley is unique in all the world. It is a priceless jewel that attracts millions of visitors. [..] we ask you to respond to the majority of Park visitors who rely upon you to ensure that Yosemite Valley is as ecologically healthy and as natural in

scenic beauty as possible. Restoring the flood-damaged campgrounds is an important first step in maintaining that ecological and social balance. (Conservation Organization, Twain Harte, CA, Comment #18-5)

- There are too many people and cars. I and a group of friends used to go to Yosemite every summer, but for the past ten years or so years we have not. If the Merced were restored to a more natural state, if there were less cars and commercial business, we would return. I am 63 years old and would not find it a hardship to carry my gear in on a shuttle bus. (Individual, Comment #23-1)
- I strongly recommend that the Park move forward with ecological restoration for all of the Upper and Lower River Campground area and a major portion of the Lower Pines Campground site. Our Center notes the following logical reasons to do ecological restoration in these areas, rather than to re-build or expand campground facilities: The sites are unarguably located in the floodplain, and thus, any campground rebuilding or construction would place campsites in a location that assuredly will flood again at some point in the future. This would be a poor use of public finds, and would fail to provide for long-term, manageable campgrounds. Sewer, electrical, and structural improvements would all be at risk. (Conservation Organization, Twain Harte, CA, Comment #18-1)

The National Park Service should choose other developed areas for restoration rather than the flood-damaged campgrounds.

- In reading through the April, 2003, update, it seem that, as the east Valley campgrounds are upgraded, there will still be, in the end, fewer campsites than there used to be, with the flood-damaged campgrounds at Upper and Lower River and a portion of Lower Pines being restored to natural conditions. I applaud restoration, but I wish the areas could be taken from developed sections, rather than making less space for campers...Camping is the best way to experience the essence of Yosemite, as my family has for four generations. (Individual, Comment #13-1)

Water Resources

The National Park Service should locate campgrounds away from the Merced to preserve water quality.

- Public health and safety can only be served by locating campgrounds outside of the floodplain. This alone should ensure that alternative locations are considered for campgrounds. Imagine a sudden early summer flood event due to warm rain on the snowpack. All federal actions must priority public health and safety. Human activities at campgrounds produce varying levels of pollutants that can contaminate water (including petroleum products with high potential for harming water quality in the river or adjacent wetlands). By relocating campgrounds to more appropriate locations further back from the River or outside the Valley, the potential for the introduction of non-point source pollution into the river will be markedly reduced. (Conservation Organization, Twain Harte, CA, Comment #18-3)

Wetlands

The National Park Service should restore the Merced River floodplain to its natural wetland conditions.

- The Merced River is the lifeblood and center of the ecological web of life in the Valley, and it naturally overflows its banks (and actually will move to varying degrees to create new channels) as flood events and storm events dictate. The areas in question were naturally wetlands in the past and were part of the habitat utilized by aquatic species (such as amphibians) that evolved in the Valley. It is crucial that essential wetland areas be restored, since amphibians and other aquatic species have declined precipitously in recent decades. (Conservation Organization, Twain Harte, CA, Comment #18-2)

Vegetation (not rare, threatened or endangered)

The National Park Service should restore flood-damaged campgrounds to meadow habitat.

- I favor complete restoration to pre-campground natural conditions. I understand that the Rivers and Lower Pines Campgrounds areas were meadowlands. And that they were changed by adding fill material which also enabled the forest invasion. I also understand if you remove the trees, and the fill material, natures natural processes will reestablish the meadows. I request complete meadow restoration. I feel meadows are among the most valuable, and also abused, natural resources of Yosemite. I favor continuing to bite the bullet on these closed campgrounds and return them, as much as possible to their full meadow habitat. (Individual, Oakdale, CA, Comment #20-2)

The National Park Service should remove unnatural overgrowths of trees and use the timbers for park boardwalks.

- Can we set a standard for Yosemite's future by removing the trees we have as a result of mans mismanagement (this requires logging in my mind) and save and store the timbers thus gained for a future very good quality boardwalk that might want to be built at El Capitan Meadow? The Yosemite forest is a continually growing, very overgrown, resource. Managing this resource and reversing man's mistakes of a century are necessary steps of restoration and proper management in Yosemite. (Individual, Oakdale, CA, Comment #20-3)

Wildlife (not rare, threatened or endangered)

The National Park Service should consider wildlife movement along the river corridor when planning Yosemite Valley campground restoration.

- Wildlife movement east and west through the river corridor floodplain is biologically essential for certain wildlife species. The campground areas slated for restoration are some of the only undeveloped areas in that general part of the Valley. This means that essentially there is little or no other available open space for wildlife movement along the river corridor. As such, we suggest that trail development and interpretive and recreation activities planned here be sensitive to wildlife patterns and use of the area. For example, large group activities should not be planned during peak movement times; for some species this occurs in the early morning or at dusk. (Conservation Organization, Oakland, CA, Comment #14-7)

Visitor Experience

The National Park Service should rebuild and reopen the flooded campgrounds.

- Camping in the valley along the river is a tremendous and very Yosemite experience. You see the moon rise over Half Dome, walk back to camp after a ranger talk, listen to the calls for "Elmer," linger in the cool on Stoneman Bridge, but you are in YOSEMITE. Will visitors get the same experience in the proposed fringe campgrounds, I don't think so. (Individual, Midpines, CA, Comment #19-3)
- I am in favor a re opening all the flooded campgrounds. The purpose of Yosemite is for all to enjoy, not the select few who can afford to stay in motels or hotels in the Park. It seems that Yosemite's plan is "if we can just get rid of these people, Yosemite would be a wonderful place". That is not the purpose of our Parks. Spend the money on reopening the campgrounds. (Individual, Glendale, CA, Comment #6-1)
- Quit taking things away from the people and at least compromise by giving some of the old campground space back! The infrastructure in those campgrounds are not in bad shape, people know this. The Valley is a precious place but my kids have never even been to the top of Half Dome because we can't get a place to camp in the Valley anymore. I for one will continue to fight to get at least some of our old campground space back. (Individual, Fawnskin, CA, Comment #17-2)

The National Park Service should move several congested drive-in campsites from Upper Pines to the east end of the Upper River Campground.

- At least, please look at the possibility of moving a few existing, overly congested drive-in campsites that are still jammed too close together in the Upper Pines inner-loops… These campsites are still too congested. I suggest that you change your staunch positions about a small part of the Upper Rivers area, and move just a few of those crowded drive-in campsites from the upper loop, Upper Pines area, over to the east end of the Upper Rivers campground. (Individual, Truckee, CA, Comment #24-2)
- I only wish that you could see that some of the old Upper River campground area would be perfect for about 50 to 75 campsites, which would not be added to the total, but instead, taken from the still over crowded drive-in sites that you aren't planning to change much in the Upper Pines area. These sites will still be too congested, even after all the planning. (Individual, Truckee, CA, Comment #12-1)

The National Park Service should improve the campsite reservation system.

- As of now my family has visited Yosemite twice in 15 years because my wife has to stay on the phone for eight hours trying to reserve a campsite six weeks in advance for a seven day stay, but we only get four days at a site not of our choosing! (Individual, Fawnskin, CA, Comment #17-1)

The National Park Service should retain the Lower River Amphitheater.

- I would NOT like to see the lower river amphitheatre removed for the following reasons: It is beautiful, rustic, appropriately styled, and unobtrusive. It is of very tasteful and sparse log construction, I guess built in the late 1980s or early 90s. It's a very precious and valuable resource for education and interpretive events of all kinds. Although it's right across the river from the Housekeeping cabins area, it's screened by vegetation and has a wonderful, remote feeling. It's an ideal, central location for talks and events in the summer--away from the busy scene of Curry Village but just a short walk from it. (Individual, Comment #8-1)
- In order to maximize the learning experience potential" of this special part of the park however, we strongly suggest that the National Park Service strive to keep the Lower River Amphitheater in place as long as might be possible. (Recreational Organization, San Rafael, CA, Comment #7-2)

Visitor Experience

The National Park Service should consider moving the Lower River Amphitheater to an alternate and previously disturbed location.

- According to the Yosemite Valley Plan, the Lower Rivers Amphitheater is slated for removal. We understand that this structure has some architectural and aesthetic qualities to it, however if retained in its current location, would likely compromise the restoration effort. As such, we recommend that the Park Service attempt to move the structure to a more appropriate previously disturbed location that will be easy for visitors to access by foot, bike, or shuttle. (Conservation Organization, Oakland, CA, Comment #14-9)

The National Park Service should include a day use picnic area as part of the restoration of flood damaged campgrounds.

- It would be very nice if a picnic area could be included in the restoration project in the flooded campgrounds so people from Curry Village could walk to it. (Individual, San Rafael, CA, Comment #3-1)

The National Park Service should keep visitors out of the vegetated areas that separate campsites.

- [..] you could rope off the vegetation and keep only the campsites accessible to campers, much like some of the California State Campgrounds have done, to keep people out of vegetation that separates the campsites. If you did that, I do think that people would not complain as much, once they experienced camping in a nicely separated campsite area like that, they would be the most sought after campsites you have. (Individual, Truckee, CA, Comment #12-2)

Park Operations

The National Park Service should develop trails in the area using the least toxic trail materials.

- We support the development of multi-use trail to link Yosemite Village area with Curry Village and other trails. We do not think a paved surface is necessary for the multi-use trail, however, should it be necessary we recommend that you consider using the least toxic materials possible, including evaluation non-asphalt alternatives such as decomposed granite. (Conservation Organization, Oakland, CA, Comment #14-8)